



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

February 13, 2013

Engineering/Planning Division
Geo-Environmental Engineering Branch

Ms. Lynne Jennings
EPA - New England, Region 1
5 Post Office Square - Suite 100
Mail Code OSRR7-3
Boston, Massachusetts 02109-3912

Mr. Len Pinaud
Commonwealth of Massachusetts
Department of Environmental Protection – Southeast Regional Office
20 Riverside Drive
Lakeville, Massachusetts 02347

Re: Impact Area Groundwater Study Program (IAGWSP), Final Northwest Corner
Environmental Monitoring Report, June 2011 through June 2012, dated February 2013

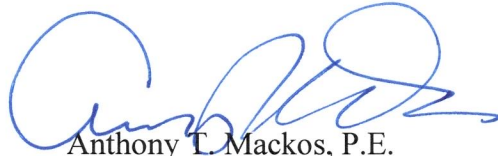
Dear Ms. Jennings and Mr. Pinaud:

On behalf of the Army National Guard's Impact Area Groundwater Study Program (IAGWSP), the U.S. Army Corps of Engineers (USACE) is pleased to provide the Final version of the subject report.

The Draft version of this document was submitted in September 2012. Comments were received from the U.S. Environmental Protection Agency (EPA) in a letter dated October 18, 2012, and from the Massachusetts Department of Environmental Protection (MassDEP) in a letter dated October 15, 2012. A Response to Comments Letter (RCL) was written on November 9, 2012. EPA provided additional comments by e-mail on November 26, 2012. MassDEP provided subsequent comments during the comment resolution meeting (CRM) on December 13, 2012. A Memorandum of Resolution (MOR) was written on January 8, 2013 (included as Appendix B of the Final report). EPA and MassDEP approved of the MOR in letters dated January 29, 2013, and January 16, 2013, respectively. A signed Project Note summarizing the approved changes to the monitoring well network is included as Appendix A of the Final report.

Please contact Dave Hill of the IAGWSP, or Mark Anderson of the USACE, if there are any questions.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Anthony T. Mackos', is positioned above the printed name.

Anthony T. Mackos, P.E.
Chief, Engineering/Planning Division

Enclosure
EPA 1 copy and 1 CD
MassDEP 1 copy and 1 CD

Copy Furnished:

IAGWSP: Ben Gregson (letter only), Dave Hill (1 copy), and Marcia Goulet (5 copies and 2 CDs)

EPA: Bob Lim (1 copy), Desiree Moyer (1 copy), Erin Sanborn (1 CD)



Impact Area Groundwater Study Program

FINAL

Northwest Corner Environmental Monitoring Report June 2011 through June 2012

**Camp Edwards
Massachusetts Military Reservation
Cape Cod, Massachusetts**

February 2013

Prepared for:

Army National Guard
Impact Area Groundwater Study Program
Camp Edwards, Massachusetts

Prepared by:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

DISCLAIMER

This document has been prepared pursuant to government administrative orders (U.S. EPA Region I SDWA Docket No. I-97-1019 and 1-2000-0014) and is subject to approval by the U. S. Environmental Protection Agency. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency.

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1.0 INTRODUCTION

The Northwest Corner (NWC) site is located within portions of Training Areas B-9 and B-11 in the northwest corner of the Massachusetts Military Reservation (MMR). It is generally bounded by Kirbe Road to the north and northeast, Orchard Road to the east, a power line easement to the south, and the Cape Cod Canal outside the installation boundary to the northwest (Figure 1-1).

Groundwater sample collection in the northwestern corner of Camp Edwards began in 1999 under the Impact Area Groundwater Study Program (IAGWSP) Gun & Mortar Position investigation and as part of an installation-wide groundwater sampling program. A long-term groundwater monitoring plan specifically designed for the NWC site was later developed to provide continuing information on the nature and extent of perchlorate and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) plumes (AMEC, 2005) detected in this area. In that plan, specific network monitoring wells, sampling frequencies, and laboratory analyses were selected to provide information on plume dynamics over time and to support decision-making during the remedial investigation/feasibility study (RI/FS) process. With the installation of additional groundwater monitoring wells and completion of characterization efforts in the ensuing years, network wells, frequencies, and analyses changed to accommodate plume configurations and observed concentration trends.

This report summarizes the results for explosives and perchlorate data for those wells sampled between June 2011 and June 2012. The *Final Northwest Corner Remedial Investigation/Feasibility Study (RI/FS)* (Tetra Tech, 2009) summarized data through May 2008.

Based on data collected through June 2012, the RDX plume measures approximately 5,160 feet long by 470 feet wide, as referenced to the 0.6 microgram per liter ($\mu\text{g/L}$) RDX iso-concentration contour. The perchlorate plume is not as long (3,516 feet) but at its widest point measures approximately 1,016 feet as referenced to the 2 $\mu\text{g/L}$ perchlorate iso-concentration contour.

2.0 SAMPLING PROGRAM

Between July 2011 and June 2012, there were two sampling rounds, a semi-annual round in November 2010, and an annual round conducted in May/June 2012. The semi-annual round consisted of sampling one well cluster (MW-441M1/M2) for explosives by EPA Method 8330, and five samples for perchlorate by EPA Method 6850. The annual sampling program consisted of the collection of nine samples for explosives and 26 samples for perchlorate. The *Final Northwest Corner Environmental Monitoring Work Plan*, Impact Area Groundwater Study Program, Massachusetts Military Reservation, Cape Cod, Massachusetts, prepared by U.S. Army Corps of Engineers, Concord, Massachusetts (March 2012), summarizes this 2012 sampling program.

Figure 2-1 and Figure 2-2 identify the wells that are part of the explosives and perchlorate monitoring networks, respectively. Table 2-1 presents the sampling frequencies and parameters analyzed by well for the reporting period.

3.0 MONITORING RESULTS

Analytical results during the reporting period are discussed in the following sections. Analytical data has been validated according to the *Final IAGWSP Generic Quality Assurance Project Plan* (QAPP; Tetra Tech, 2012). Associated data packages and data validation reports are accessible on the Massachusetts Military Reservation (MMR) Electronic Data Management System (EDMS).

A summary of RDX and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), the only explosives detected in the wells sampled during the reporting period, and perchlorate are provided in Table 3-1. A map depicting wells with RDX detections using color coded well symbols is presented on Figure 3-1. For those wells with a semi-annual sampling frequency the highest concentration detected during the year is used for color coding purposes. A similar map depicting perchlorate detections during the monitoring period is presented in Figure 3-2. Plan views of the RDX and perchlorate plumes have been updated using data through June 2012. The following provides a discussion of the explosives and perchlorate results.

3.1 EXPLOSIVES

RDX – RDX was detected in six of 11 samples (excluding duplicates), at detectable concentrations ranging from 0.34 µg/L (MW-323M1) to 11 µg/L (MW-441M2). Three samples contained RDX at concentrations greater than the risk based concentration (RBC) of 0.6 µg/L. This included one sample from MW-323M1 and two samples from MW-441M2. Only samples collected from MW-441M2 (7.33 µg/L in November 2011 and 11 µg/L in May 2012) contained RDX at a concentration greater than the EPA Lifetime Health Advisory of 2 µg/L. The sample collected from MW-441M2 was the maximum RDX concentration detected during this reporting period and was consistent with the 11.3 µg/L observed in this well during the April 2011 sampling event. The historical maximum detected RDX was present at a concentration of 15 µg/L in MW-441M2 in November 2009.

HMX - HMX was the only other explosive compound detected during the reporting period. It was detected in two of 11 samples and only detected in the samples collected from MW-441M2 at concentrations of 0.47 µg/L (November 2011) and 0.87 µg/L (May 2012). The EPA Health Advisory for HMX is 400 µg/L.

3.2 PERCHLORATE

Perchlorate was detected in 30 samples of 30 samples, excluding duplicates, at concentrations ranging from 0.039J µg/L (MW-338S) to 3.39 µg/L (MW-284M2). Three samples contained perchlorate at concentrations exceeding the Massachusetts Maximum Contaminant Level (MMCL)/Massachusetts Contingency Plan (MCP) GW-1 standard of 2 µg/L. Concentrations above 2 µg/L were detected in two samples from monitoring well MW-284M2 and one sample from MW-279M2. The maximum detected perchlorate concentration (3.39 µg/L) was detected in MW-284M2 (November 2011).

The maximum detected perchlorate concentration detected in the prior reporting period was also detected at MW-284M2 (4.79 µg/L in November 2010). The historical maximum detected perchlorate concentration of 26.3 µg/L was detected in MW-279S in March 2005.

4.0 MONITORING TRENDS

Notable detections and concentration trends are summarized in the following sections.

4.1 EXPLOSIVES

Eight wells were selected to evaluate trends in the RDX concentrations in different portions of the plume: upgradient of Canal View Road, along Canal View Road, and proximate to the Cape Cod Canal. The selected wells are as follows:

- MW-441M1/M2 and MW-350M2 - Upgradient of Canal View Road
- MW-338S and MW-323M1/M2 - Canal View Road
- MW-284M1/M2 – Proximate to Cape Cod Canal

RDX results for these wells through June 2012 are plotted next to a plan view of the plume on Figure 4-1. The following summarizes the general trends for RDX.

Upgradient of Canal View Road

MW-441M1 – This well has been sampled for RDX 12 times since its installation. Results have shown a continuing decrease from the maximum concentration (1.4 µg/L) measured in July 2006. In November 2011 and in May 2012, the RDX concentrations in this well were reported at 0.58 µg/L and 0.36 µg/L, respectively.

MW-441M2 – This well has also been sampled for RDX 12 times since its installation. The first four samples (June 2006 to May 2008) contained non-detect levels of RDX. However, concentrations rose abruptly to 9.4 µg/L in April 2009 and have since fluctuated between a site-wide historical high of 15 µg/L in November 2009 and 3.3 µg/L in May 2010. The most recent sample measurements were 7.33 µg/L in November 2011 and 11 µg/L in May 2012.

MW-350M2 – This well has been sampled for RDX 12 times since its installation. Concentrations of RDX were either non-detect or less than the RBC through May 2005. A spike of RDX (1.9 µg/L) was observed in this well in October 2005 but concentrations decreased to 0.37 µg/L in April 2006, and have been non-detect in annual samples since 2007.

Canal View Road

MW-338S – This well has been sampled for RDX 19 times since its installation, and all concentrations have been non-detect or present at the reporting limit with the exception of two low-level detections (0.42 µg/L in October 2005 and 0.35 µg/L in January 2006).

MW-323M1 – This well has been sampled for RDX 12 times since its installation and concentrations have fluctuated between 1.5 µg/L (2004) and 0.48 µg/L (2011) which is

below the RBC of 0.6 µg/L. In June 2012 RDX was reported at a slight increase at 0.67 µg/L.

MW-323M2 - This well has been sampled for RDX 13 times since its installation. Detected concentrations generally fluctuated between 5.6 µg/L and 9.6 µg/L between April 2004 and May 2010 with one sample at 3.6 µg/L in April 2006. The latest concentration, 0.34 µg/L (June 2012), represents a historical low value for this well.

Proximate to Cape Cod Canal

MW-284M1 – This well has been sampled for RDX 15 times since its installation. Concentrations have ranged narrowly between 0.28 µg/L and 0.93 µg/L since sampling began in September 2003. The latest concentration was non-detect in June 2012 and represents the first non-detect value for this well .

MW-284M2 – This well has been sampled for RDX 17 times since its installation. Concentrations have remained at or below the reporting limits of 0.20 or 0.25 µg/L in the last ten sampling events (April 2006 through June 2012), after ranging narrowly between 0.27 µg/L and 0.38 µg/L between September 2003 and January 2006.

RSNW06 – This residential well has been sampled for RDX 28 times since its installation. Concentrations have ranged narrowly between non-detect and 0.33 µg/L (May 2004) since sampling began in May 2003. RDX has been non-detected since May 2005 through the latest sampling round in May 2012.

Based on concentrations in these three wells being below the RBC of 0.6 µg/L, the 0.6 µg/L iso-contour on Figure 4-1 was drawn slightly upgradient of RSNW06. Additionally, the 2 µg/L contour has been slightly adjusted to exclude MW-323M2. A comparison between the RDX plume contoured with data through June 2011 and through June 2012 is presented in Figure 4-2.

4.2 PERCHLORATE

Fourteen wells were selected to evaluate trends in perchlorate concentrations in different portions of the plume: upgradient of Canal View Road, along Canal View Road, and proximate to the Cape Cod Canal. These wells are:

- MW-298S, MW-441M1 and 95-16 - Upgradient of Canal View Road
- MW-278S/M1/M2 and MW-279S/M1/M2 - Canal View Road:
- MW-270S/M1/D, MW-284M2 and MW-297M1 – Proximate to Cape Cod Canal

The following summarizes the general trends for perchlorate (Figure 4-3).

Upgradient of Canal View Road

MW-298S - This well has been sampled for perchlorate 13 times since its installation. Perchlorate concentrations ranged narrowly between 0.57 µg/L and 0.96 µg/L between February 2004 and August 2005 and have been non-detect in 6 of the last 7 samples collected since December 2005. A 0.061 J µg/L detection in April 2009 resulted from a change in analytical methodology (E314.0 to SW-846 Method 6850). In May 2012 perchlorate was detected at 0.5 J µg/L.

MW-441M1 – This well has been sampled for perchlorate 11 times since its installation. A perchlorate concentration of 0.72 J µg/L was detected in the initial sample in July 2006 and concentrations have declined since, ranging from non-detect to 0.18 J µg/L between November 2008 and May 2012 when perchlorate was detected at 0.054 J µg/L

95-16 – This well has been added back into the NWC perchlorate sampling network. It was first sampled in May 2003 at a non-detected value. Semi-annual sampling resumed in April 2011 and was reported as a non-detected value. The highest reported value for this well was in May 2010 at 0.39 µg/L. Trace levels of perchlorate were detected in June 2012 at 0.089 J µg/L.

Canal View Road

MW-278S – This well has been sampled 21 times for perchlorate since its installation. Concentrations of perchlorate ranged from 10.5 µg/L to 15.9 µg/L between June 2005 and September 2006, but had declined to 2.8 µg/L by April 2009. Concentrations have remained below 2 µg/L since November 2009, recently measuring 0.70 µg/L in June 2012.

MW-278M2 - This well has been sampled for perchlorate 27 times since its installation in 2003 with perchlorate detected in all samples. Most detections have been near 2 µg/L with spikes of 7.4 µg/L and 12.4 µg/L in December 2003 and April 2006, respectively. Perchlorate concentrations have steadily declined in annual samples collected since 2006 and most recently measuring 1.75 µg/L (June 2012).

MW-278M1 – This well has been sampled for perchlorate 23 times since its installation. Concentrations have ranged narrowly between 0.51 µg/L (November 2004) and 2.6 µg/L (April 2006). The sample collected in June 2012 contained perchlorate at 0.86 µg/L.

MW-279S – This shallow well has been sampled for perchlorate 37 times since its installation. Concentrations in this well have fluctuated over the course of its sampling history. Monthly samples collected between December 2003 and December 2004, saw concentrations ranging from approximately 10 µg/L to 23 µg/L, and reached a maximum of 26.3 µg/L in March 2005. Since then concentrations have continued to fluctuate while exhibiting an overall declining trend. The well contained perchlorate at 0.97 µg/L in June 2012.

MW-279M2 – This well has been sampled for perchlorate 23 times since its installation. Concentrations have consistently been above 2 µg/L and were above 10 µg/L between May 2005 (14 µg/L, the historic maximum) and April 2009. The most recent sample contained 2.48 µg/L perchlorate (June 2012).

MW-279M1 - This well has been sampled for perchlorate 22 times since its installation. Concentrations ranged between 2.2 µg/L and 6.2 µg/L between July 2003 and July 2005. A maximum concentration of 8.1 µg/L was detected in April 2006. Concentrations have steadily decreased since then, with the most recent detection being 0.30 µg/L in June 2012.

Proximate to Cape Cod Canal

MW-284M2 – This well has been sampled for perchlorate 19 times since its installation in 2003. Concentrations have ranged from a low of 2.52 µg/L (June 2012) to a historic high of 6.7 µg/L (November 2008). Since November 2008 concentrations of perchlorate have been on the decline and was recently detected at 2.52 µg/L (June 2012), its lowest measured concentration.

MW-270S – This well has been sampled for perchlorate 16 times since its installation in 2003. Concentrations ranged narrowly between 1.5 µg/L and 2.3 µg/L between February 2005 and May 2009. Concentrations in 2011 and 2012 were below 1 µg/L, with the latest sample containing perchlorate at 0.56 µg/L (June 2012).

MW-270M1 – This well has been sampled for perchlorate 17 times since its installation. Concentrations were mostly near or above 10 µg/L from 2003 to 2007. Since the historic high of 14.6 µg/L in December 2005 concentrations have been declining and fell below 2 µg/L in June 2011. Perchlorate measured 0.68 µg/L in the latest sampling round (June 2012).

MW-270D – This well has been sampled for perchlorate 19 times since its installation. Concentrations have consistently been below 2 µg/L throughout its sampling history. The sample collected in June 2012 was detected at 0.11 µg/L.

MW-297M1 - This well has been sampled for perchlorate 14 times since its installation in 2003. Concentrations ranged narrowly between 1.5 µg/L and 2.1 µg/L between December 2003 and April 2006. In April 2007 concentrations rose to 2.6 µg/L and have since declined consistently. The samples collected in May 2011 (0.92 µg/L) and June 2012 (0.67 µg/L) were both below the 2 µg/L MMCL/MCP GW-1 standard.

Based on recent results from well clusters MW-270, MW-278, MW-279 and well MW-297M1, the 2 µg/L perchlorate plume iso-contour has been reduced to a smaller footprint. A comparison of the perchlorate plume using data through June 2011 and the plume using data through June 2012 is presented in Figure 4-4.

4.3 COMPARISON TO DECISION DOCUMENT CRITERIA

The Decision Document outlined that contamination within the broad perchlorate plume is expected to drop below the 2 µg/L MMCL by 2012 and the 0.35 µg/L background level by 2019. Contamination within the narrow RDX plume is expected to drop below the 2 µg/L health advisory by 2012, the 0.6 µg/L 10-6 risk-based concentration by 2022, and the 0.25 µg/L background level by 2044. The numerical

fate and transport model depicts that the perchlorate plume is located approximately 400 feet upgradient of the canal as of 2012.5 (5.5 years after plume shell development November 2006). However, based on recent measurements the perchlorate plume has been drawn to be approximately 3600 feet upgradient of the canal. Currently, two wells (MW-279M2 & MW-284M2) have concentrations exceeding 2 µg/L. The lingering of the plume can likely be attributed to residual leaching of perchlorate mass in the unsaturated zone along Canal View Road. Wells MW-298S and 95-16 are located upgradient and east of MW-279M2 and are currently below 0.35 µg/L. Thus, as clearly visible from the hydrograph depicted on Figure 4-3, MW-279M2/S continues to display a diminishing trailing edge of the perchlorate plume. When perchlorate drops below 2 µg/L in MW-279M2, it will then take approximately 5-6 years, based on advective flow (unattenuated), to fully discharge to the canal. As such, the most upgradient portion of the plume would reach the canal by 2019-2020 and background concentrations (0.35 µg/L) should occur shortly thereafter.

With respect to RDX, at the time the plume shell was developed (November 2006), RDX was non-detect in MW-441M2, the furthest upgradient well in the NWC operable unit. As depicted in Figure 4-1, concentrations increased from ND (< 0.25 µg/L) in May 2008 to 9.4 µg/L in April 2009 and have been above 2 µg/L since. Unfortunately, the next closest upgradient well is over 3000 feet away and the terrain in between is quite rugged. A series of profile samples located approximately 1650 feet upgradient of MW-441 were collected from borings DP-373 through DP-376 and DP-394 beginning in May 2005. RDX results in these samples did not exceed 2 µg/L. Therefore, until concentrations of RDX fall below 2 µg/L a reliable estimate of time to cleanup cannot be established. However, once concentrations are below 2 µg/L at MW-441M2, the advective time of travel to the canal is approximately 8 years. So at a minimum, concentrations of 2 µg/L throughout the RDX plume would not be achieved until 2020.

5.0 RECOMMENDATIONS

Based on the data trends presented above, it is recommended that the following changes be made to the explosives and perchlorate LTM sampling program:

Explosives

- MW-283M1, MW-270M1 & MW-270D – These wells are proximate to the Cape Cod Canal and have not been part of the LTM sampling program since 2004. The groundwater model contaminant plume shell coupled with measured water levels may indicate a possible shift of the RDX plume to the northwest. If this assumption is correct, RDX could be discharging into the canal at MW-283M1, MW-270M1 and MW-270D, as these locations are currently not monitored. It is recommended that these wells be added to the NWC sampling program on a one time basis for the 2013 NWC sampling program in order to better understand the current groundwater contours.

Perchlorate

There are currently no recommended changes to the NWC groundwater monitoring, well network, sampling, frequencies or parameters for perchlorate.

Table 5-1 provides the summary of recommended changes to the Environmental Monitoring Program. One well (MW-283M1) and one well cluster (MW-270M1 and MW-270D) are recommended to be added to the NWC LTM plan for explosives on a one time basis as these wells are located downgradient of MW-441 and MW-323 which has historically detected RDX. The groundwater model contaminant plume shell coupled with measured water levels may indicate a possible shift of the RDX plume to the northwest. If this assumption is correct, RDX could be discharging into the canal at MW-283M1, MW-270M1 and MW-270D, as these locations are currently not monitored. It is recommended that these wells be added to the NWC sampling program on a one time basis for the 2013 NWC sampling program in order to better understand the current groundwater contours. A Project Note summarizing these changes and approved by the regulators is presented in Appendix A.

Additionally, annually the IAGWSP will evaluate the model predicted plume contours to measured values and determine whether significant variances are likely within cleanup time frames published in the Decision Document. If so, the groundwater flow model will be used to estimate revised times of cleanup, if feasible.

6.0 REFERENCES

AMEC, 2005. *Draft Northwest Corner Interim Groundwater Monitoring Plan*, Impact Area Groundwater Study Program, Massachusetts Military Reservation, Cape Cod, Massachusetts. Prepared by AMEC Earth and Environmental, Westford, Massachusetts. December 1, 2005. (Environmental Data Management System (EDMS) Document ID 8365)

Tetra Tech, 2009. *Final Northwest Corner Remedial Investigation/Feasibility Study Report*, Impact Area Groundwater Study Program, Massachusetts Military Reservation, Cape Cod, Massachusetts. Prepared by Tetra Tech EC, Inc., Boston, Massachusetts. September 2009. (EDMS Document ID 9256)

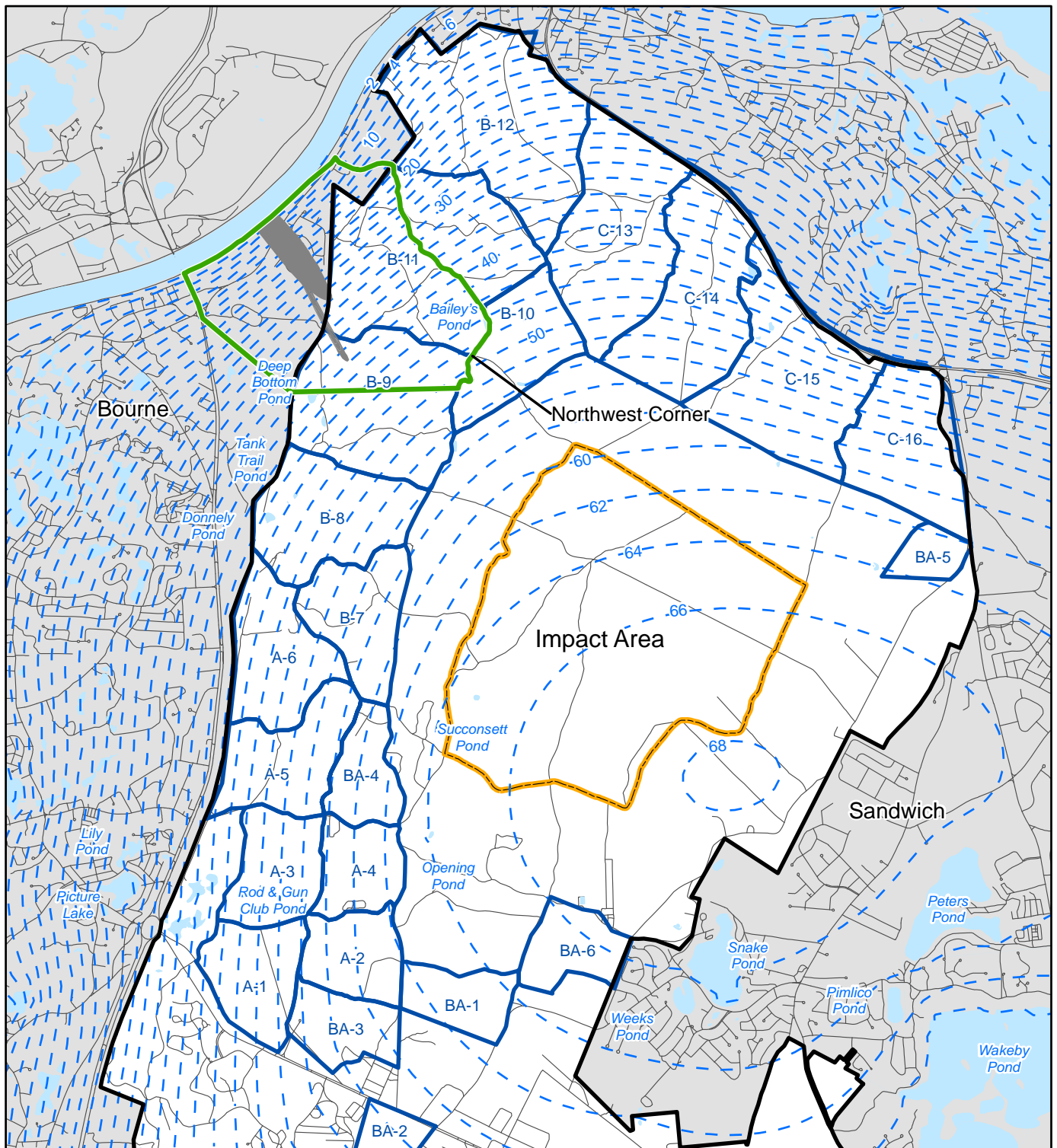
Tetra Tech, 2012. *Final IAGWSP Generic Quality Assurance Project Plan*. Impact Area Groundwater Study Program, Massachusetts Military Reservation, Cape Cod, Massachusetts. Prepared by Tetra Tech EC, Inc. February, 2012. (EDMS Document ID 113291)

USACE 2012. *Final Northwest Corner Environmental Monitoring Work Plan*, Impact Area Groundwater Study Program, Massachusetts Military Reservation, Cape Cod, Massachusetts. Prepared by U.S. Army Corps of Engineers, Concord, Massachusetts. March 2012 (EDMS Document ID 113287)

USACE 2011. *Final Northwest Corner Environmental Monitoring Report*, June 2010 through June 2011, Impact Area Groundwater Study Program, Massachusetts Military Reservation, Cape Cod, Massachusetts. Prepared by U.S. Army Corps of Engineers, Concord, Massachusetts, October 2011 (EDMS Document ID 11228)

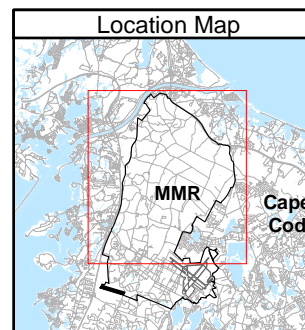
Watermark, 2011. *Final Northwest Corner Interim Environmental Monitoring Report – November 2009 through June 2010*, Impact Area Groundwater Study Program, Massachusetts Military Reservation, Cape Cod, Massachusetts. Prepared by Watermark Environmental, Inc., Lowell, Massachusetts. October 2011. (EDMS Document ID 112063).

FIGURES



Legend

- MMR Boundary
- Impact Area Boundary
- Training Areas
- Northwest Corner Site Boundary
- Perchlorate and RDX Plumes
- Groundwater Elevation Contours**
(in feet above NGVD)
- Water Level Contours - MMR10



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Feet

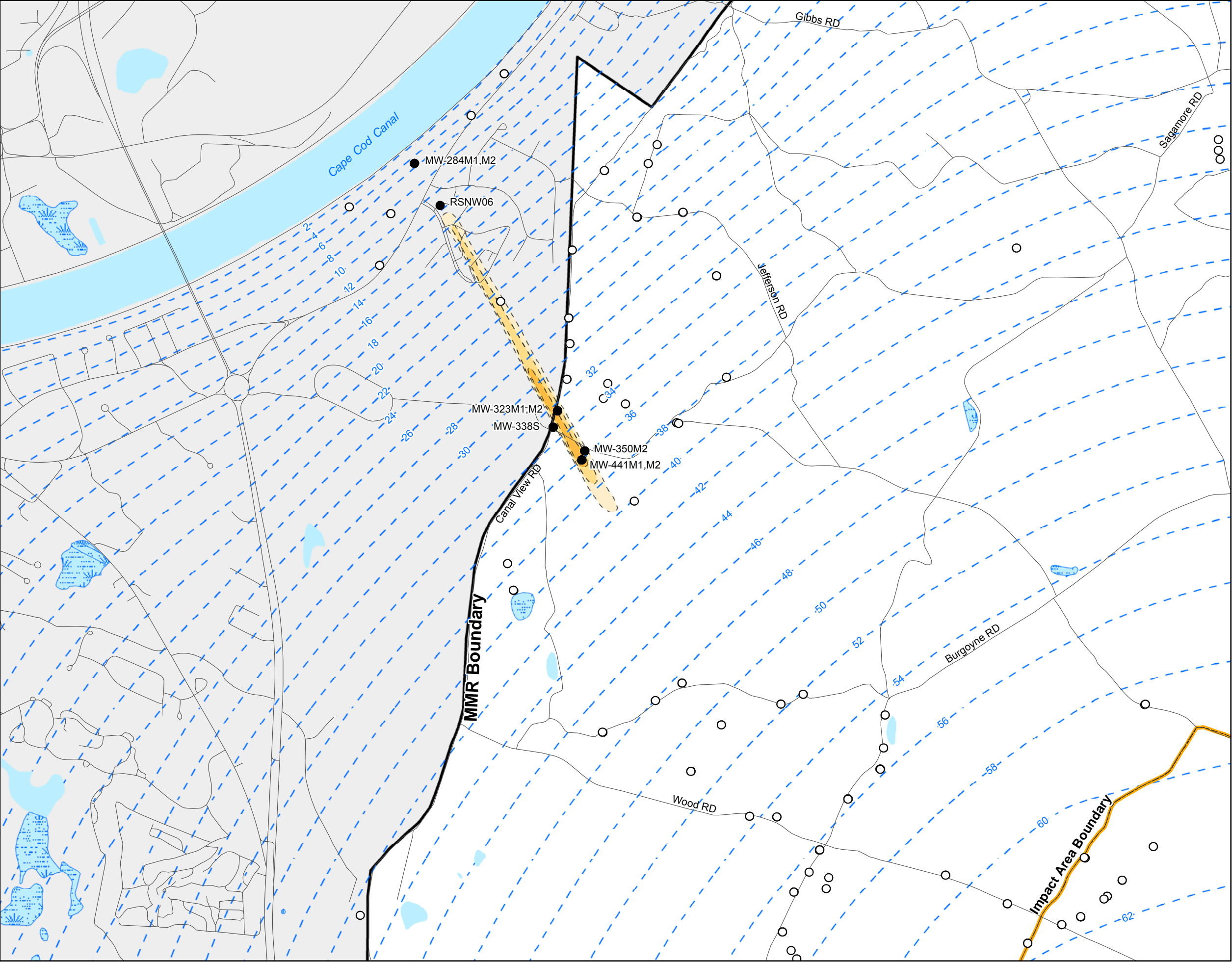



Location of Northwest Corner

FIGURE

1-1







Impact Area
Groundwater Study Program

LEGEND

Monitoring Wells

- Well Included in Explosives Monitoring Plan
- Well Not Included in Explosives Monitoring Plan

RDX in Groundwater
(Contours Dashed Where Inferred)

- 0.6 to 2 µg/L
- 2 to 6 µg/L
- 6 to 20 µg/L

Groundwater Elevation Contours
(in feet above NGVD)

- Water Level Contours - MMR10

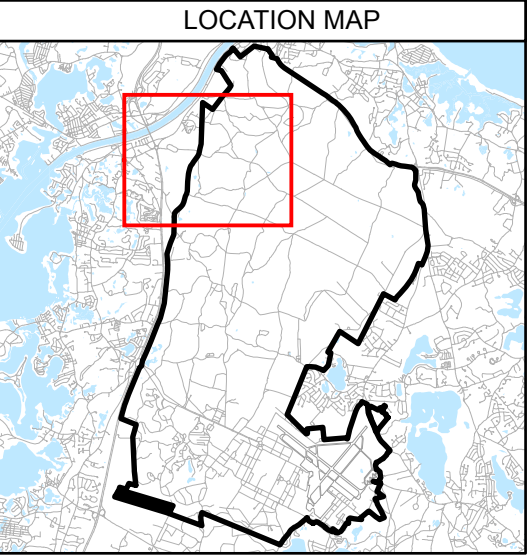
MMR Boundary

Impact Area Boundary

Groundwater Elevation Contours
(in feet above NGVD)

- Water Level Contours - MMR10

Note: Groundwater data through June 2012.
Contour lines dashed where inferred.






NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

TITLE

Northwest Corner
Monitoring Wells in
Explosives Monitoring Program



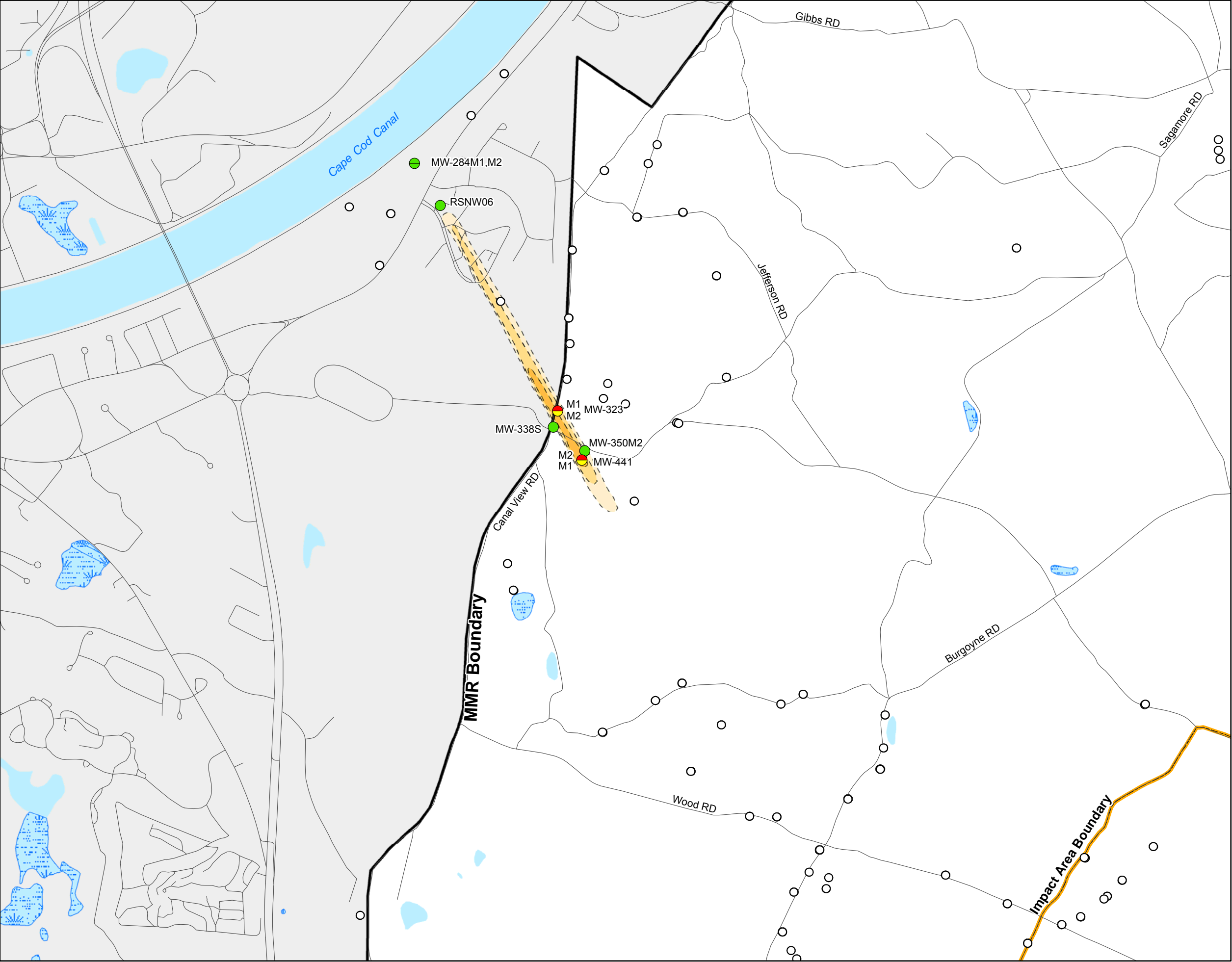



US Army Corps
of Engineers
New England District

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FIGURE

2-1





Impact Area
Groundwater Study Program

LEGEND

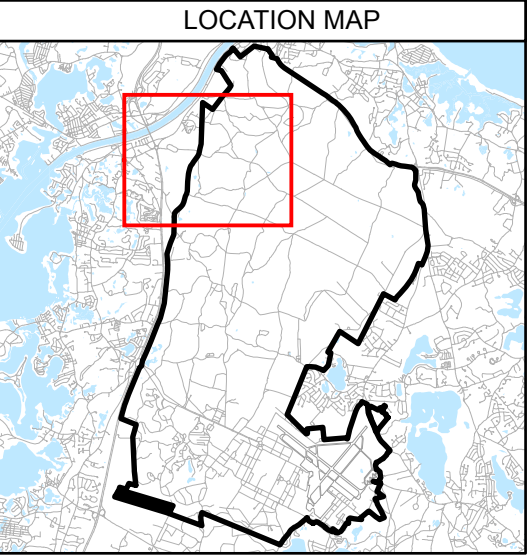
Monitoring Wells

- Well Not Included in RDX Monitoring Plan
- No Detection
- Detection at or below 0.6 µg/L
- Detection above 0.6 µg/L
- Indicates different detections in different well screens

RDX in Groundwater
(Contours Dashed Where Inferred)

- 0.6 to 2 µg/L
- 2 to 6 µg/L
- 6 to 20 µg/L
- MMR Boundary
- Impact Area Boundary

Note: Groundwater data through June 2012.
Contour lines dashed where inferred.




NOTES & SOURCES


Basemap data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

TITLE

Northwest Corner
Groundwater Contaminant Results
RDX
Environmental Monitoring Program

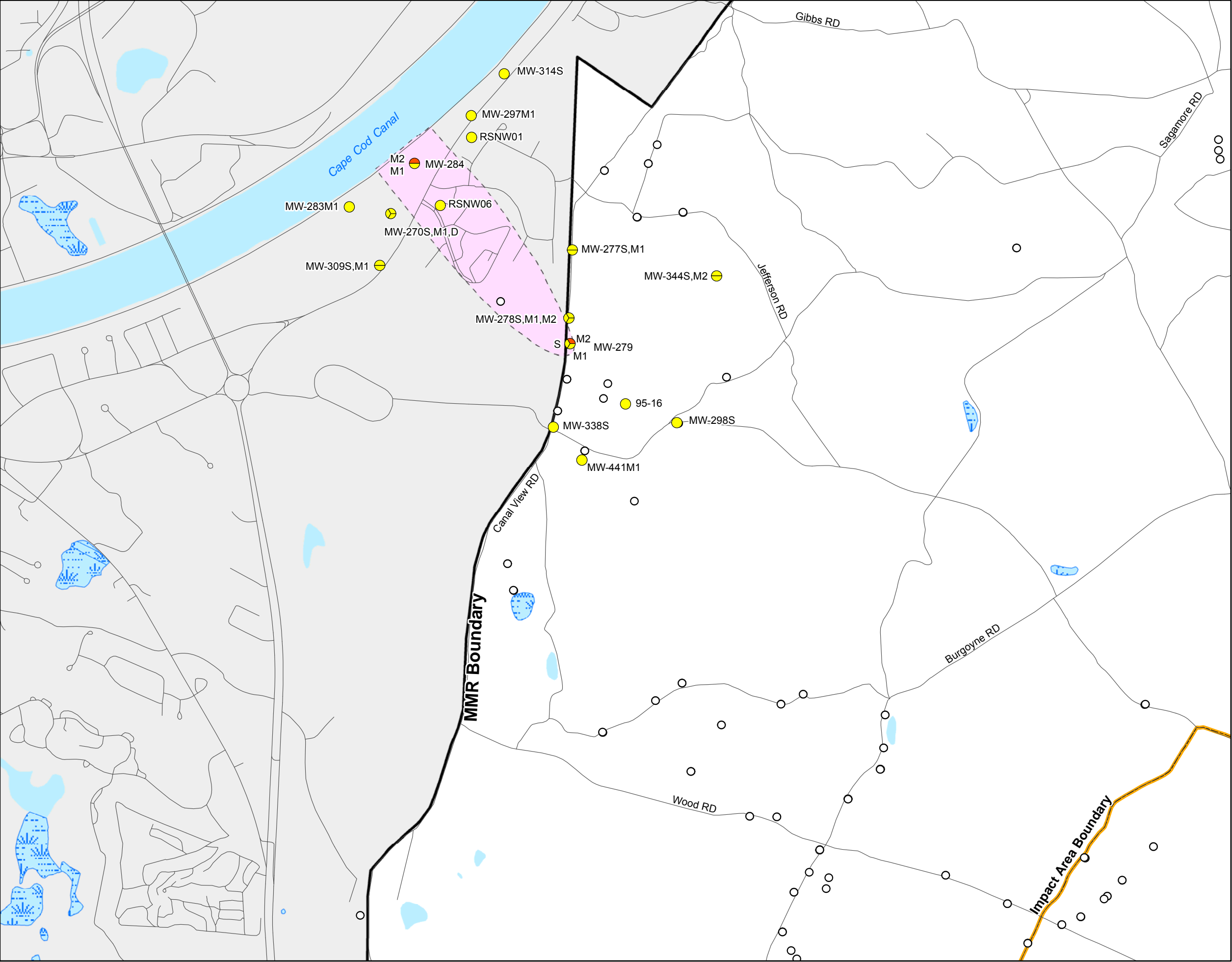
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of Engineers
New England District
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February 4, 2013 DWN: MTW CHKD: MRK

FIGURE
3-1



**Impact Area
Groundwater Study Program**

LEGEND

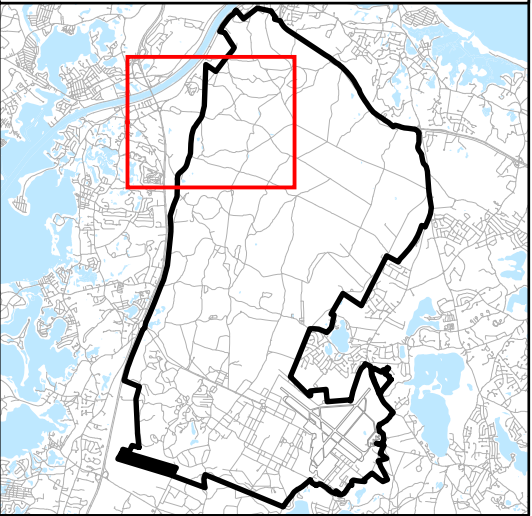
- Monitoring Wells**
- Well Not Included in Perchlorate Monitoring Plan
 - No Detection
 - Detection at or below 2 µg/L
 - Detection above 2 µg/L
 - Indicates different detections in different well screens

Perchlorate in Groundwater
(Contours Dashed Where Inferred)

- 2 to 15 µg/L
- MMR Boundary
- Impact Area Boundary

Note: Groundwater data through June 2012.
Contour lines dashed where inferred.

LOCATION MAP



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute
Topographic Maps. Source: MassGIS

TITLE

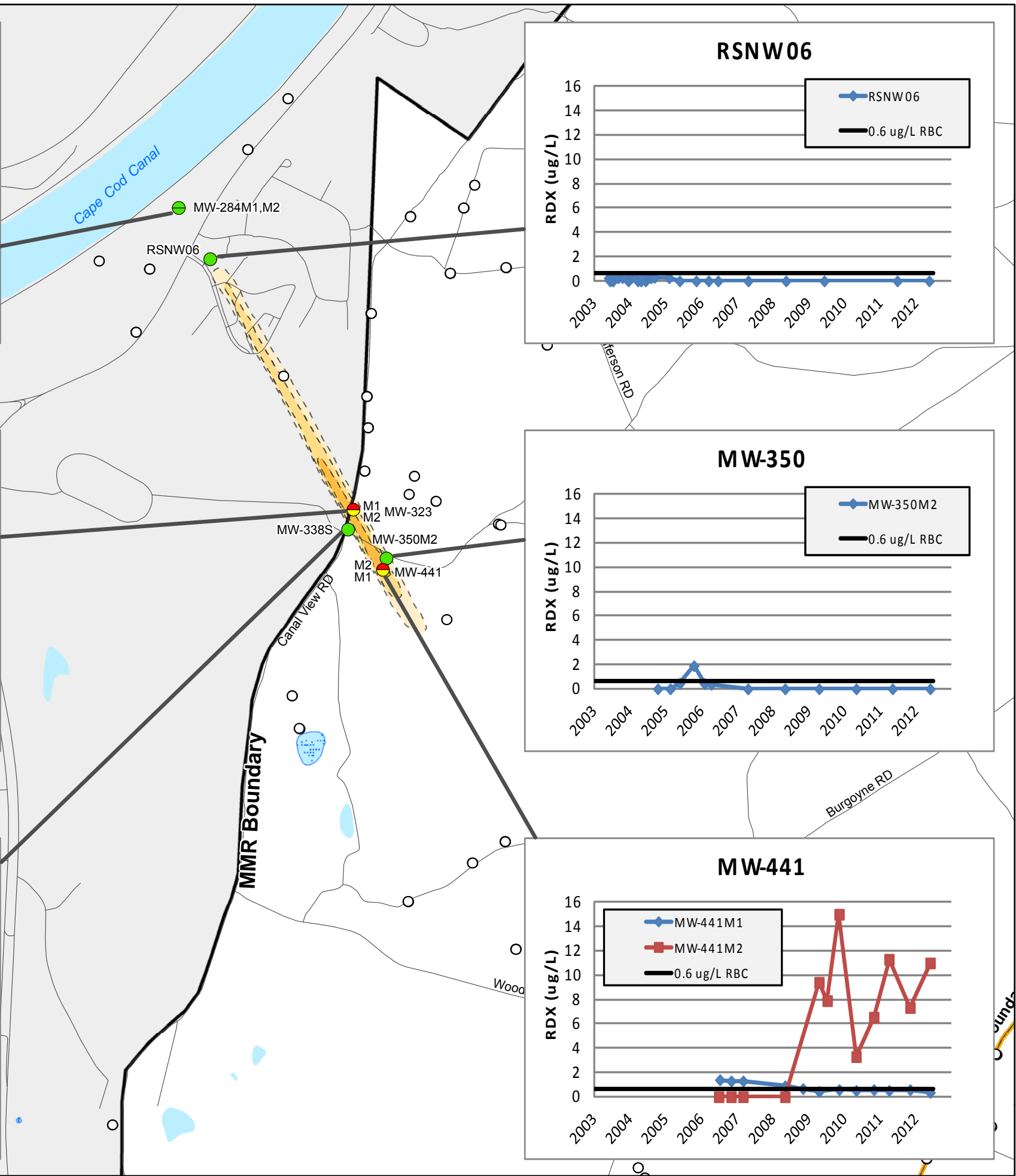
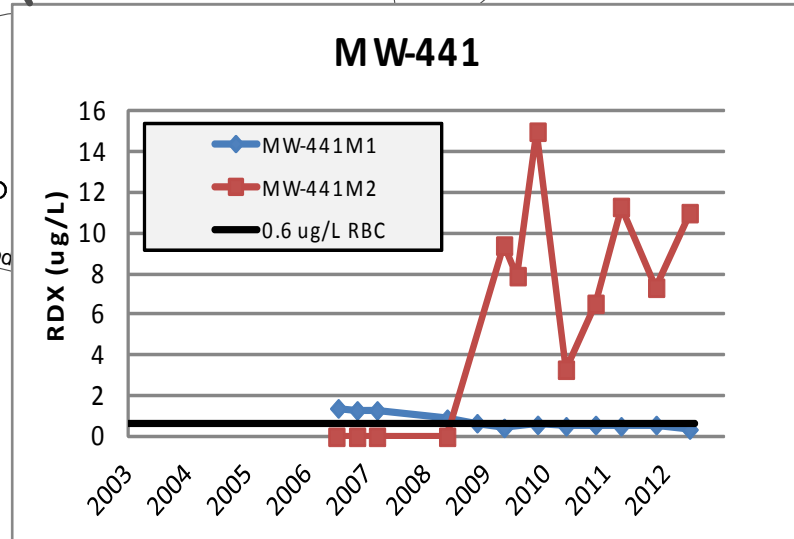
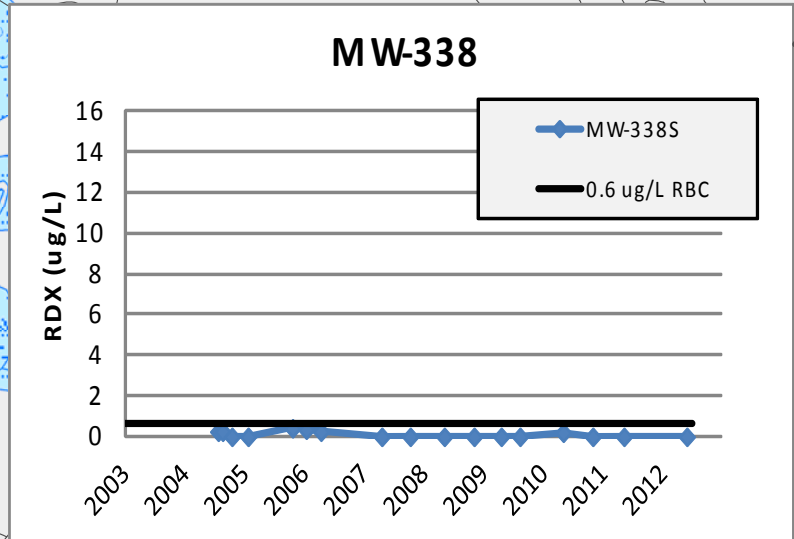
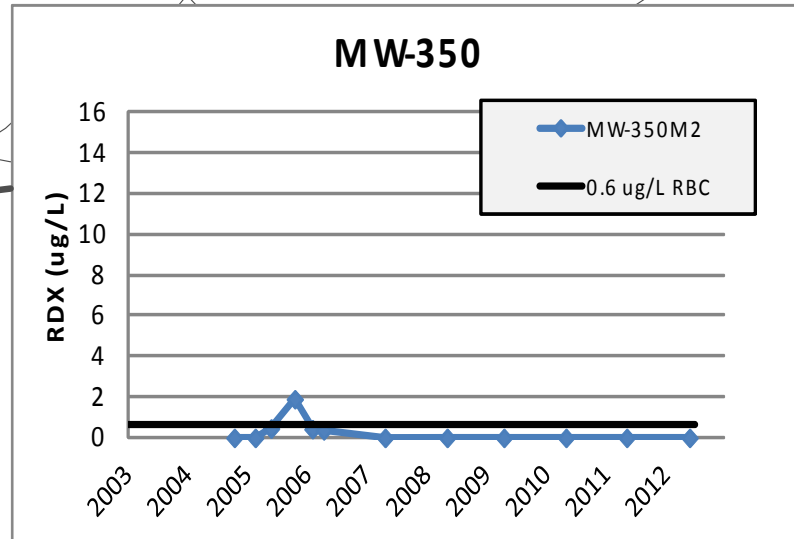
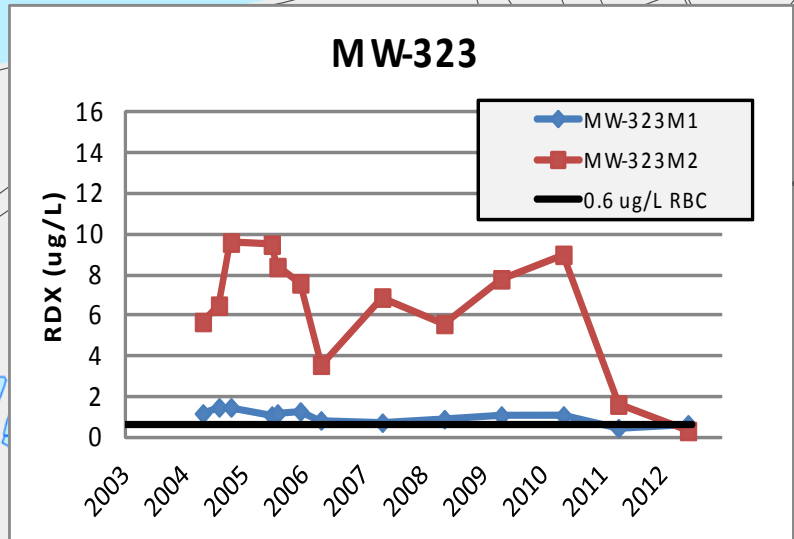
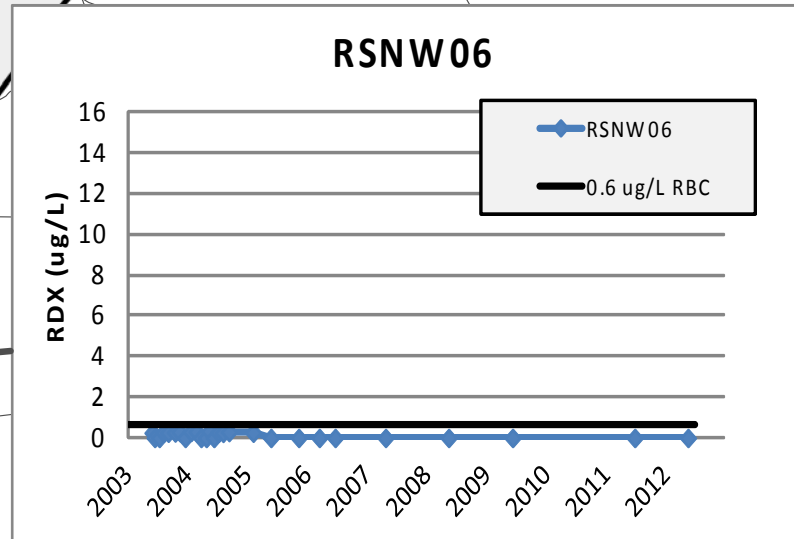
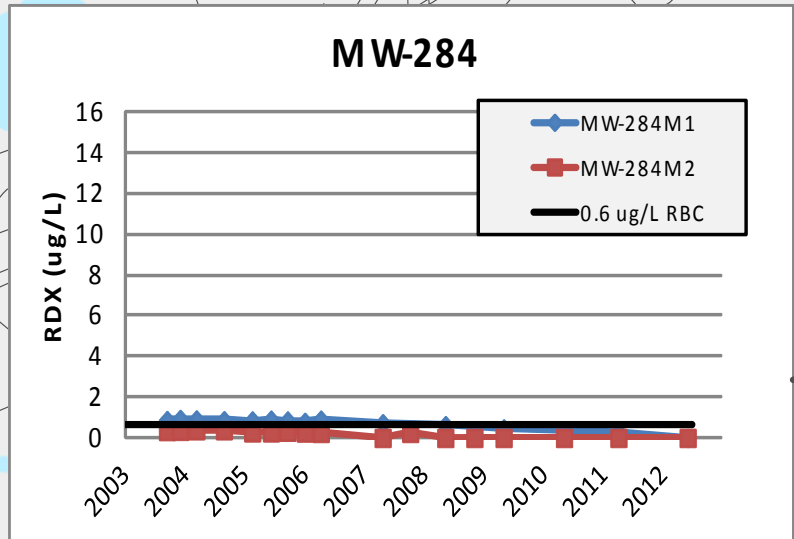
**Northwest Corner
Groundwater Contaminant Plots -
Perchlorate
Environmental Monitoring Program**

0 1,250
Feet



US Army Corps
of Engineers
New England District
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M:\MMR\2012\NWC\AnnRpt\MXD\Fig3-2_080212.mxd
August 2, 2012 DWN: MTW CHKD: MRK

FIGURE
3-2



**Impact Area
Groundwater Study Program**

LEGEND

Monitoring Wells

- Well Not Included in RDX Monitoring Plan
- No Detection
- Detection at or below 0.6 µg/L
- Detection above 0.6 µg/L
- Indicates different detections in different well screens

RDX in Groundwater
(Contours Dashed Where Inferred)

- 0.6 to 2 µg/L
- 2 to 6 µg/L
- 6 to 20 µg/L

MMR Boundary
 Impact Area Boundary

Note: Groundwater data through June 2012.
Contour lines dashed where inferred.

LOCATION MAP

NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

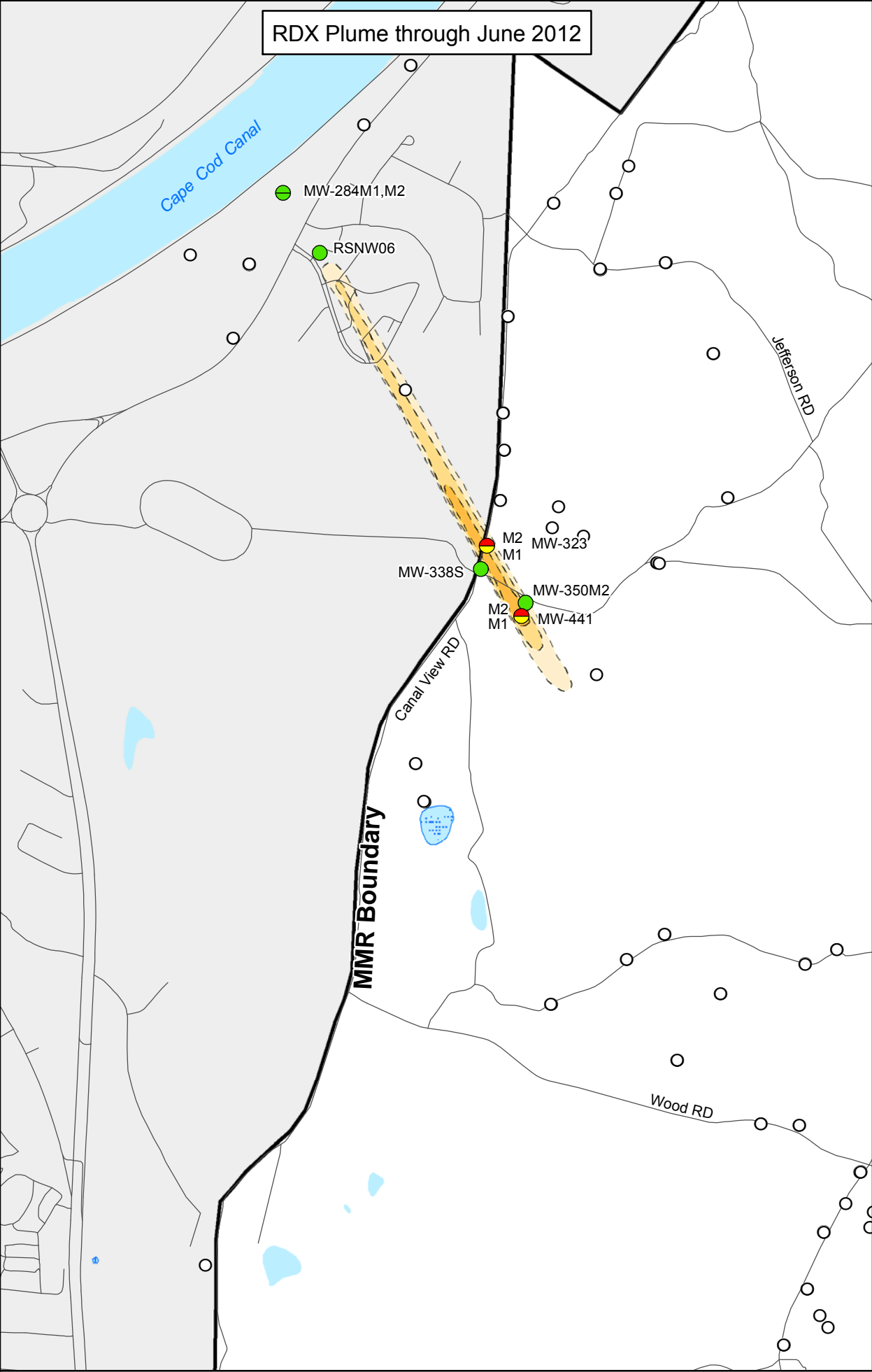
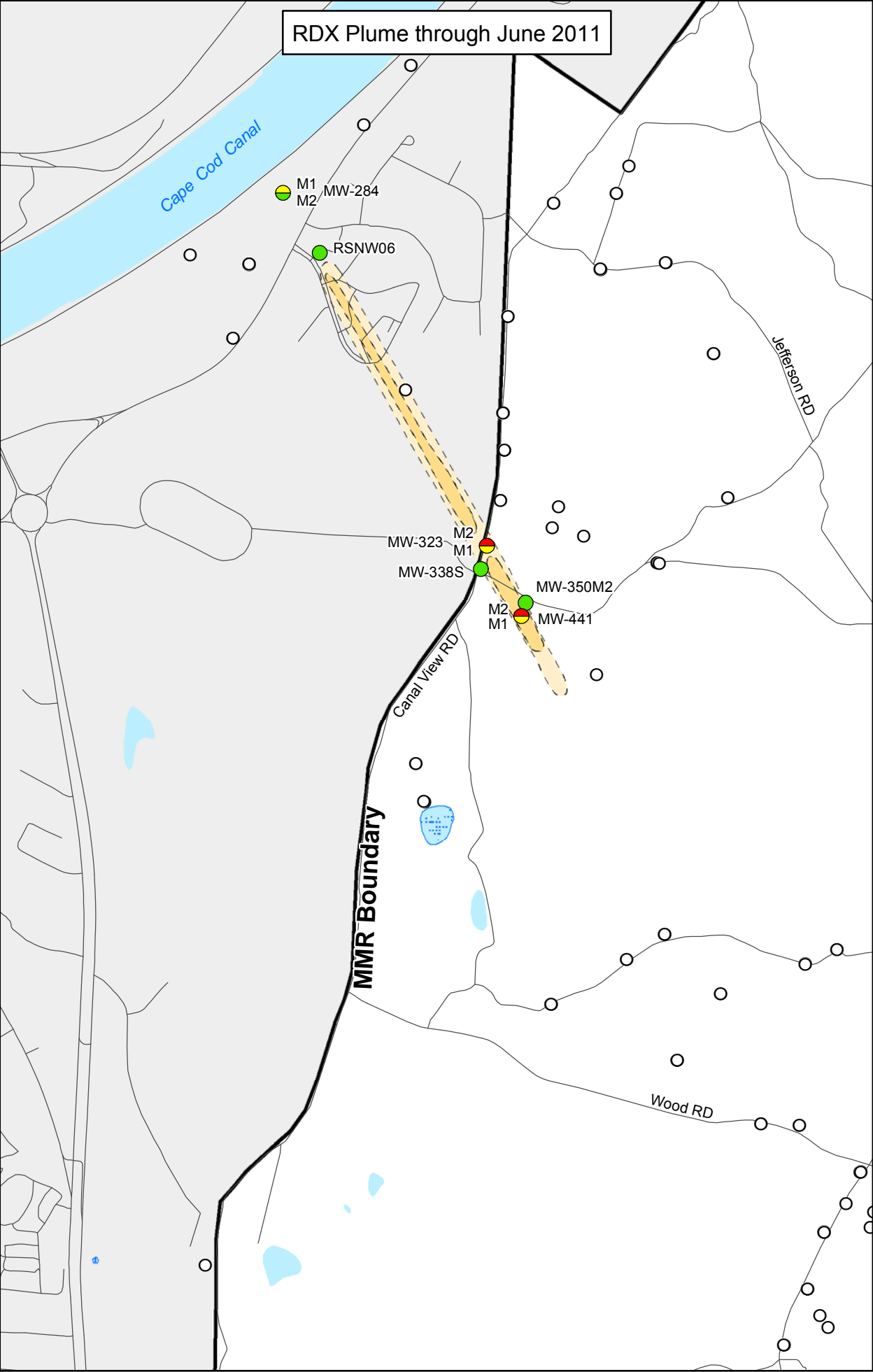
TITLE


Northwest Corner
Groundwater Contaminant Trends -
RDX
Environmental Monitoring Program

0 1,250
Feet

US Army Corps of Engineers
New England District
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M:\MMR\2012\NWC\AnnRpt\Figures\Fig4-1_080212.mxd
February 4, 2013 DWN: MTW CHKD: MRK

FIGURE
4-1



**Impact Area
Groundwater Study Program**

LEGEND
Monitoring Wells
○ Well Not Included in RDX Monitoring Plan
● No Detection
● Detection at or below 0.6 g/L
● Detection above 0.6 g/L
● Indicates different detections in different well screens



RDX in Groundwater
(Contours Dashed Where Inferred)
■ 0.6 to 2 g/L
■ 2 to 6 g/L
■ 6 to 20 g/L
▬ MMR Boundary
▬ Impact Area Boundary

Note: Contour lines dashed where inferred.

LOCATION MAP

NOTES & SOURCES
Basemap data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

TITLE
Northwest Corner
Environmental Monitoring Program
RDX Plumes
June 2011 and June 2012




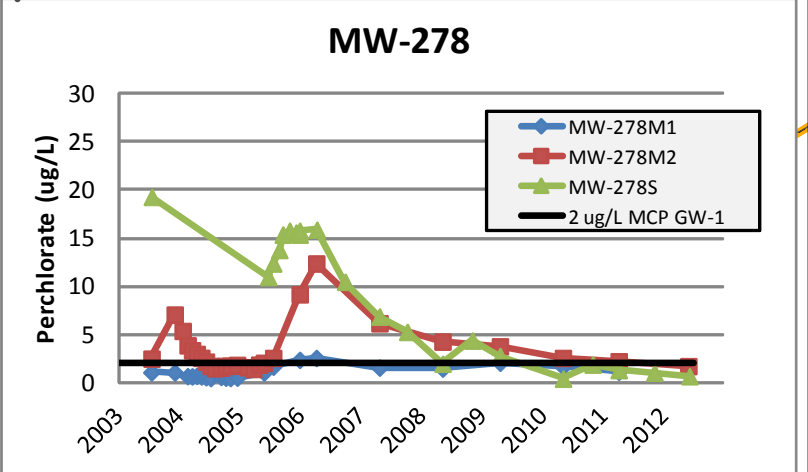
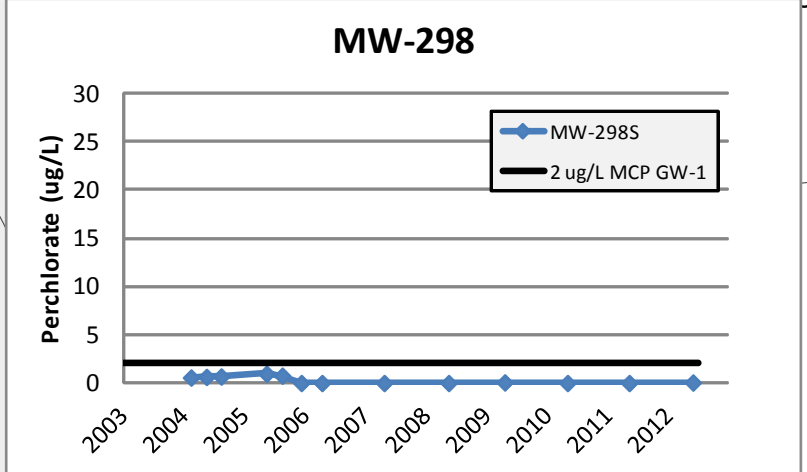
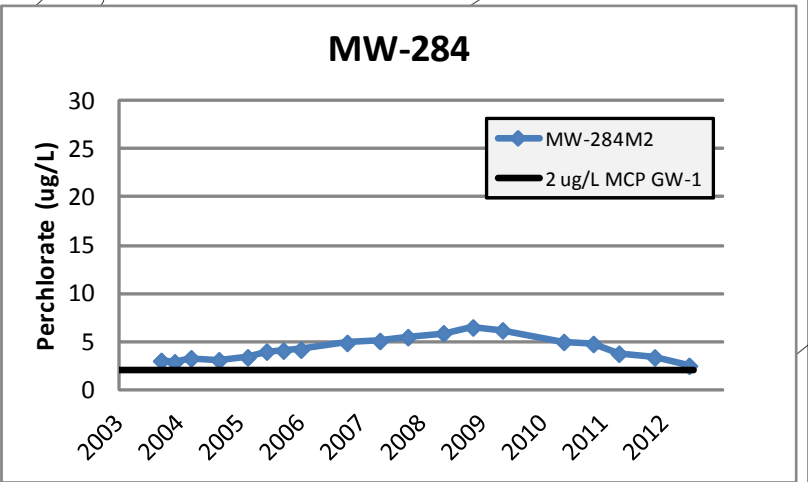
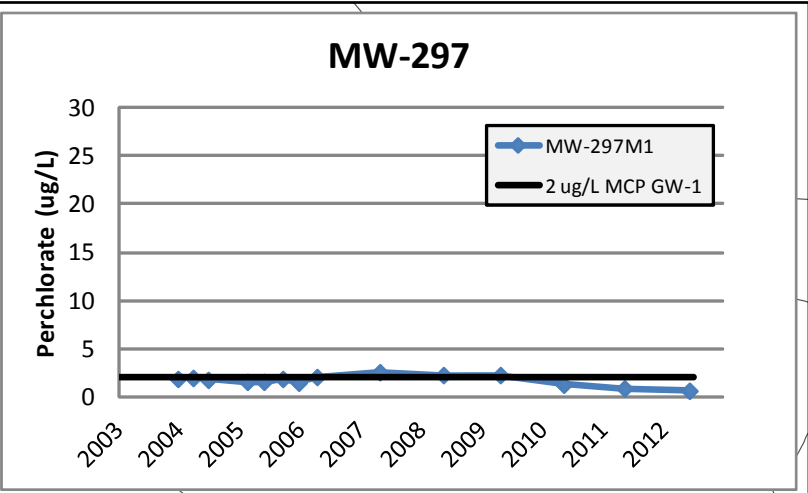
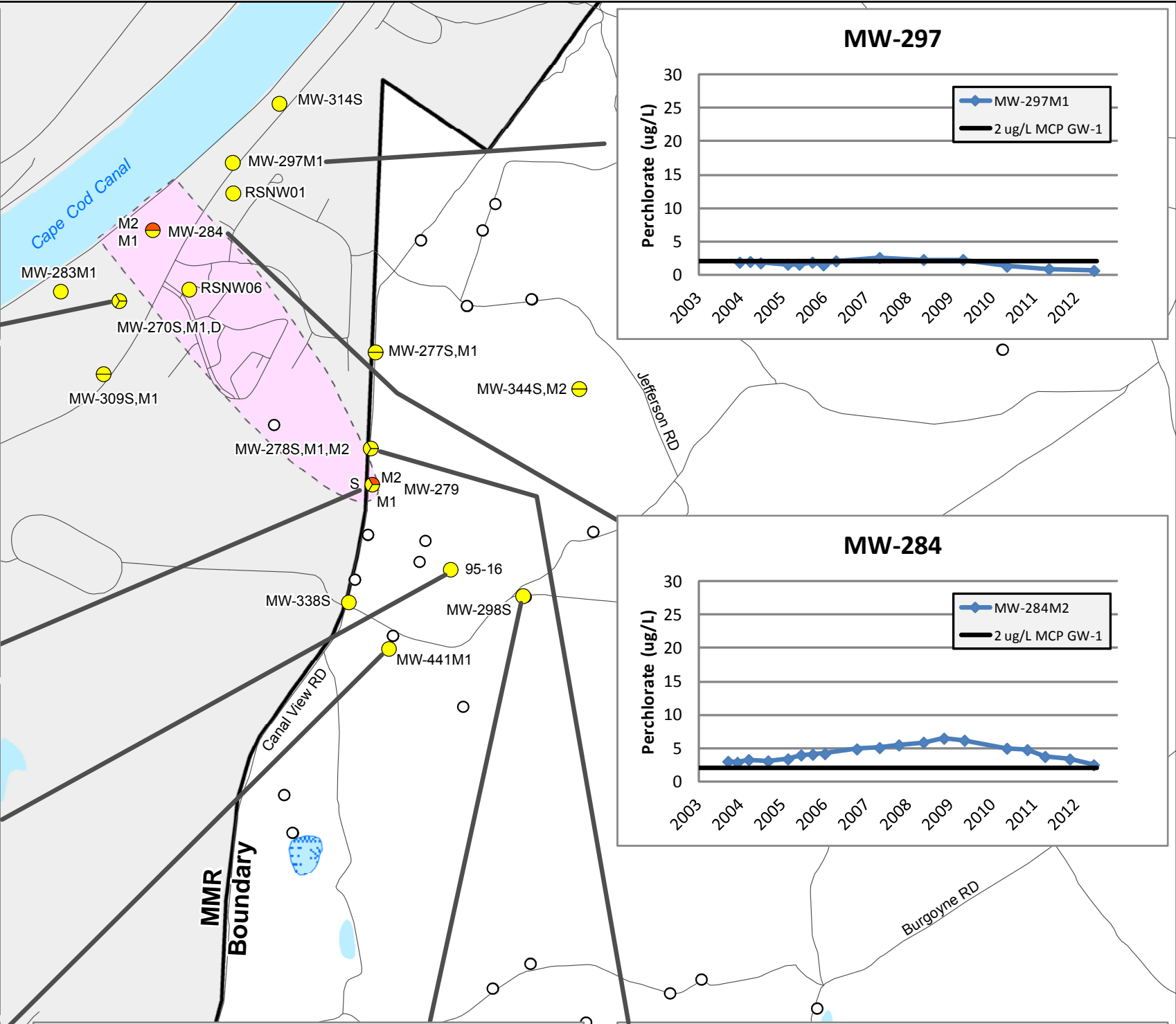
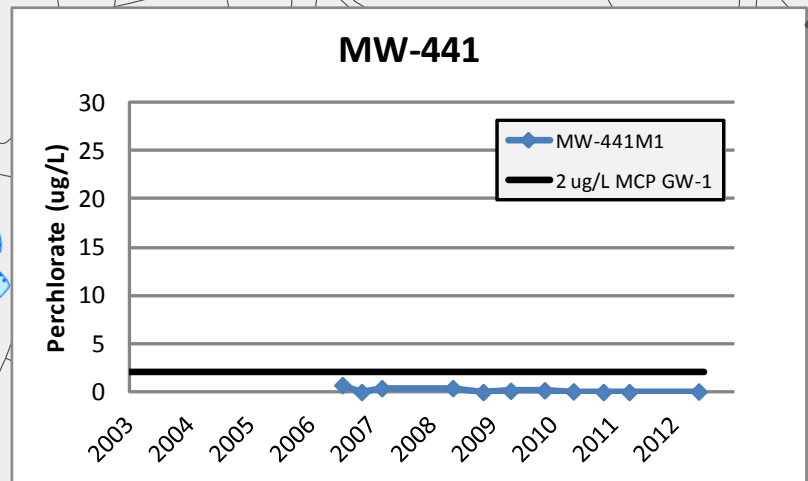
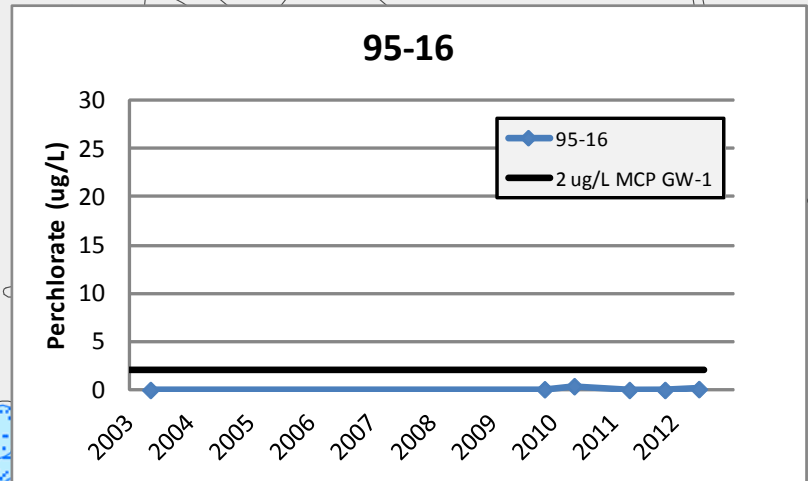
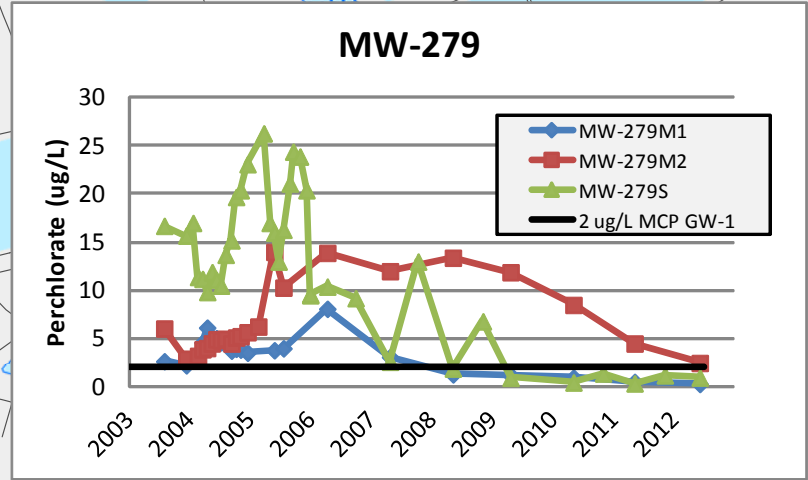
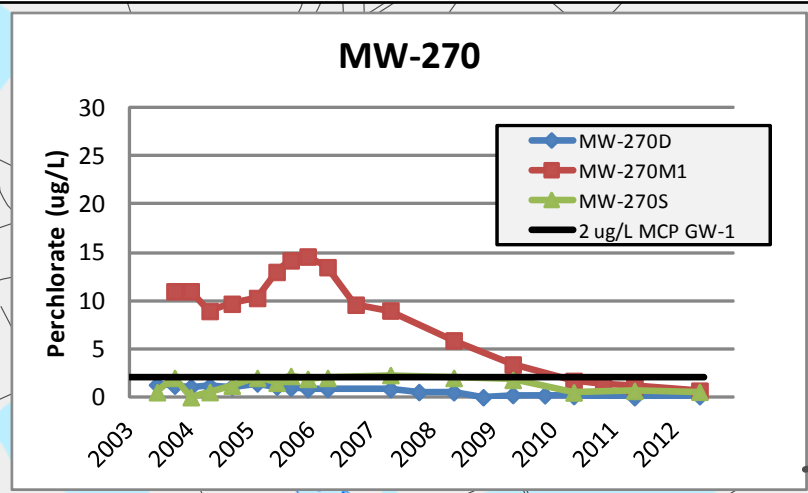
**US Army Corps
of Engineers**
New England District
M:\MMR\2012\NWC\AnnRpt\Figures\Fig4-2_010313.pdf
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January 3, 2013 DWN: MTW REV: PDM CHKD: MRK

FIGURE
4-2



Impact Area Groundwater Study Program

LEGEND

Monitoring Wells

- Well Not Included in Perchlorate Monitoring Plan
- No Detection
- Detection at or below 2 µg/L
- Detection above 2 µg/L
- Indicates different detections in different well screens

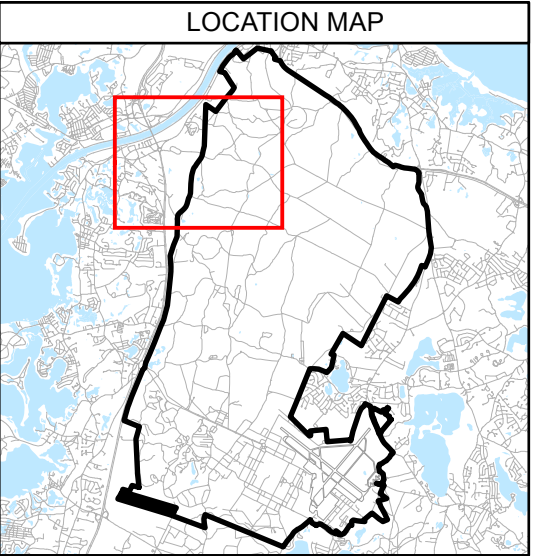
Perchlorate in Groundwater
(Contours Dashed Where Inferred)

- 2 to 15 µg/L

MMR Boundary

Impact Area Boundary

Note: Groundwater data through June 2012. Contour lines dashed where inferred.



NOTES & SOURCES

Basemap data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

TITLE

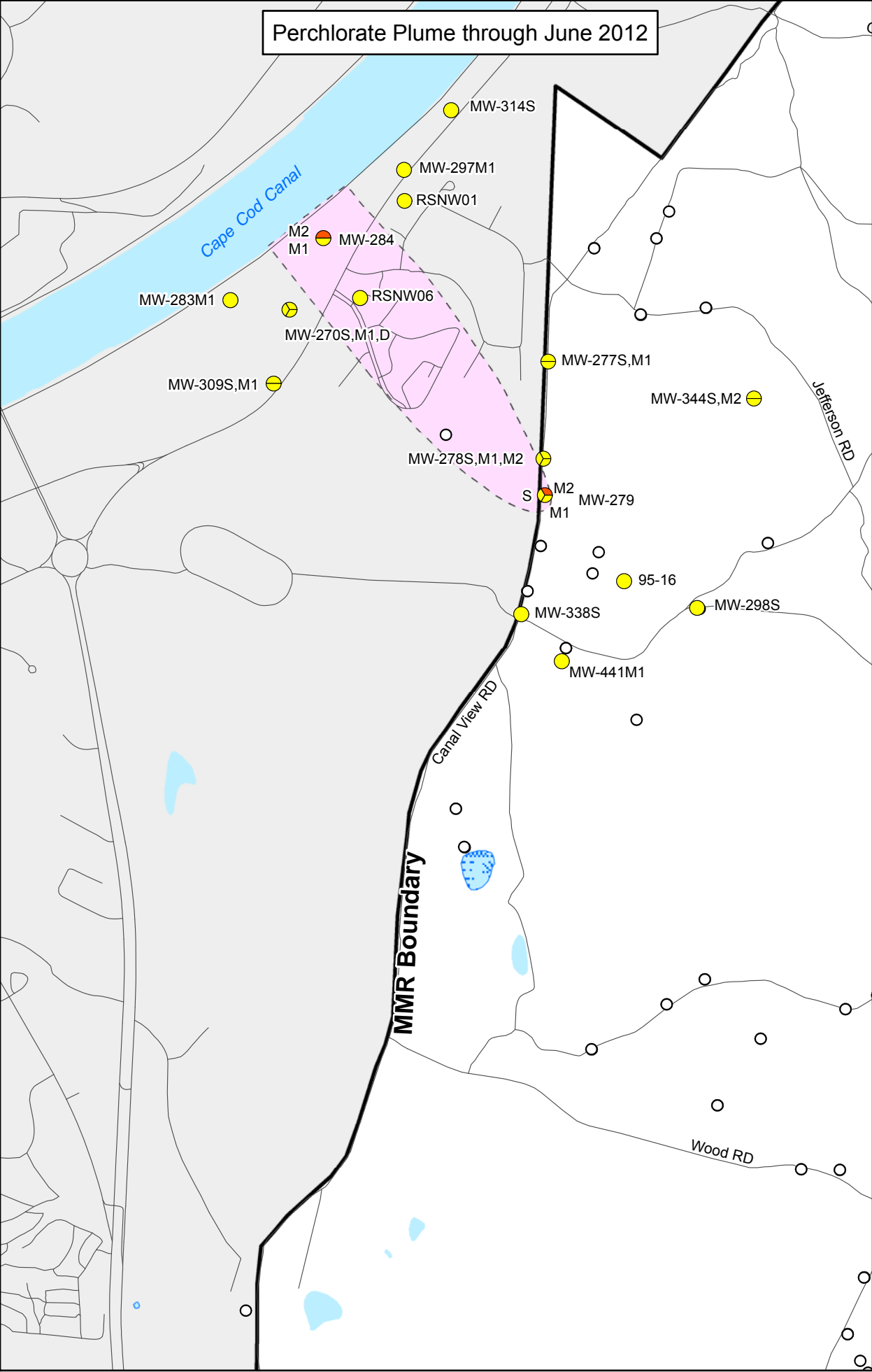
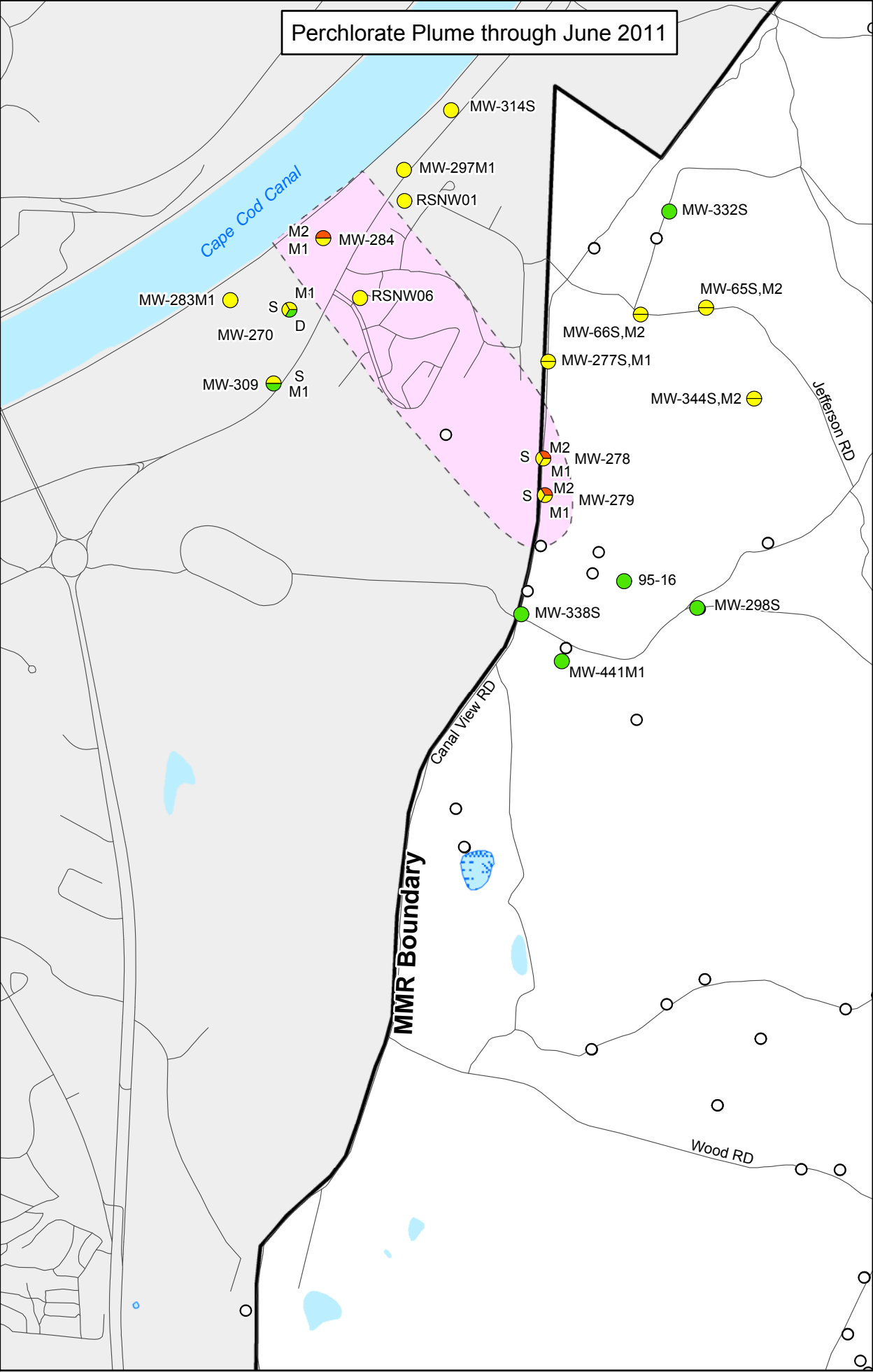
Northwest Corner
Groundwater Contaminant Trends -
Perchlorate
Environmental Monitoring Program


US Army Corps of Engineers
New England District

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August 2, 2012 DWN: MTW CHKD: MRK

FIGURE

4-3



**Impact Area
Groundwater Study Program**




LEGEND
Monitoring Wells
○ Well Not Included in Perchlorate Monitoring Plan
● No Detection
● Detection at or below 2 µg/L
● Detection above 2 µg/L
● Indicates different detections in different well screens
Perchlorate in Groundwater
(Contours Dashed Where Inferred)
2 to 15 µg/L
MMR Boundary
Impact Area Boundary

Note: Contour lines dashed where inferred.

LOCATION MAP

NOTES & SOURCES
Basemap data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

TITLE
Northwest Corner
Environmental Monitoring Program
Perchlorate Plumes
June 2011 and June 2012



US Army Corps
of Engineers
New England District
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M:\MMR\2012\NWC\AnnRpt\MXD\Fig4-4_080212.mxd
August 2, 2012 DWN: MTW CHKD: MRK

FIGURE
4-4

TABLES

Table 2-1
Northwest Corner
Groundwater Monitoring Well Network, Sampling Frequencies, and Parameters
June 30, 2011 through June 30, 2012

Well ID	Northing (UTM-m)	Easting (UTM-m)	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)	Sampling Frequency	Analysis
95-16	4622407.50	369652.50	4.3	-1.7	S	P
MW-270D	4623177.50	368703.03	-101.5	-106.5	A	P
MW-270M1	4623177.00	368703.03	-43.5	-48.5	A	P
MW-270S	4623177.50	368703.16	8.5	-1.5	A	P
MW-277M1	4623030.50	369437.16	-2.3	-12.3	A	P
MW-277S	4623030.50	369437.41	25.7	15.7	S	P
MW-278M1	4622755.50	369423.41	1.0	-9.0	A	P
MW-278M2	4622755.00	369423.41	17.0	12.0	A	P
MW-278S	4622755.00	369423.53	34.0	24.0	S	P
MW-279M1	4622651.50	369427.78	6.7	-3.3	A	P
MW-279M2	4622651.50	369427.78	19.7	14.7	A	P
MW-279S	4622651.50	369427.91	36.7	26.7	S	P
MW-283M1	4623204.50	368535.41	-24.4	-34.4	A	P
MW-284M1	4623380.50	368799.16	-86.6	-96.6	A	E,P
MW-284M2	4623380.50	368799.13	-16.6	-26.6	A,S	E,P
MW-297M1	4623574.00	369028.25	-14.2	-24.2	A	P
MW-298S	4622331.61	369860.04	42.3	32.3	A	P
MW-309M1	4622968.17	368658.26	-18.9	-28.9	A	P
MW-309S	4622967.92	368658.25	14.1	4.1	A	P
MW-314S	4623743.05	369161.74	7.1	-2.9	A	P
MW-323M1	4622379.36	369378.03	-85.4	-95.4	A	E
MW-323M2	4622379.06	369378.33	-10.4	-20.4	A	E
MW-338S	4622313.74	369360.57	37.3	27.3	A	E,P
MW-344M2	4622925.24	370021.21	1.7	-8.3	A	P
MW-344S	4622925.54	370020.91	31.2	21.2	A	P
MW-350M2	4622217.89	369487.96	-3.0	-13.0	A	E
MW-441M1	4622180.35	369475.95	-88.4	-98.4	S,A	E,P
MW-441M2	4622180.40	369475.95	6.7	-3.3	S	E
RSNW01	4623486.00	369029.81	NA	NA	A	P
RSNW06	4623210.50	368903.38	NA	NA	A	E,P

Notes:

UTM-m - Universal Transverse Mercator meters

ft msl - feet above mean sea level

A - annual

S - semi-annual

P - perchlorate

E - Explosives

NA - not available

Table 3-1
Northwest Corner Groundwater Monitoring Results
June 30, 2011 through June 30,2012

Well ID	Sample Type	Analyte	Parameter Label	Analytical Method	Results (ug/L)	Flag	Reporting Limit	Sampling Date
95-16	N1	ND for 1 Analytes	Perchlorate	SW6850	ND	U	ND	11/09/2011
95-16	N1	Perchlorate	PCATE	SW6850	0.089	J	0.20	06/01/2012
MW-270D	N1	Perchlorate	PCATE	SW6850	0.11	J	0.20	06/05/2012
MW-270M1	N1	Perchlorate	PCATE	SW6850	0.68		0.20	06/05/2012
MW-270S	N1	Perchlorate	PCATE	SW6850	0.56		0.20	06/05/2012
MW-277M1	N1	Perchlorate	PCATE	SW6850	0.22		0.20	06/06/2012
MW-277S	N1	Perchlorate	PCATE	SW6850	0.42		0.20	11/09/2011
MW-277S	N1	Perchlorate	PCATE	SW6850	0.36		0.20	06/06/2012
MW-278M1	N1	Perchlorate	PCATE	SW6850	0.86		0.20	06/01/2012
MW-278M2	N1	Perchlorate	PCATE	SW6850	1.8		0.20	06/01/2012
MW-278M2	FD1	Perchlorate	PCATE	SW6850	1.9		0.20	06/01/2012
MW-278S	N1	Perchlorate	PCATE	SW6850	1.1		0.20	11/09/2011
MW-278S	N1	Perchlorate	PCATE	SW6850	0.70		0.20	06/08/2012
MW-279M1	N1	Perchlorate	PCATE	SW6850	0.30		0.20	06/07/2012
MW-279M2	N1	Perchlorate	PCATE	SW6850	2.5		0.20	06/07/2012
MW-279M2	FD1	Perchlorate	PCATE	SW6850	2.5		0.20	06/07/2012
MW-279S	N1	Perchlorate	PCATE	SW6850	1.2		0.20	11/09/2011
MW-279S	N1	Perchlorate	PCATE	SW6850	0.97		0.20	06/07/2012
MW-283M1	N1	Perchlorate	PCATE	SW6850	1.5		0.20	06/05/2012
MW-284M1	N1	Perchlorate	PCATE	SW6850	0.35		0.20	06/05/2012
MW-284M1	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	06/05/2012
MW-284M2	N1	Perchlorate	PCATE	SW6850	3.4		0.20	11/10/2011
MW-284M2	N1	Perchlorate	PCATE	SW6850	2.5		0.20	06/05/2012
MW-284M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	06/05/2012
MW-284M2	FD1	Perchlorate	PCATE	SW6850	2.6		0.20	06/05/2012
MW-297M1	N1	Perchlorate	PCATE	SW6850	0.67		0.20	06/07/2012
MW-298S	N1	Perchlorate	PCATE	SW6850	0.050	J	0.20	05/31/2012
MW-309M1	N1	Perchlorate	PCATE	SW6850	0.12	J	0.20	06/06/2012
MW-309S	N1	Perchlorate	PCATE	SW6850	0.13	J	0.20	06/06/2012
MW-314S	N1	Perchlorate	PCATE	SW6850	0.25		0.20	06/07/2012
MW-323M1	N1	Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	SW8330	0.67		0.20	06/07/2012
MW-323M1	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	06/07/2012
MW-323M2	N1	Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	SW8330	0.34		0.20	06/07/2012
MW-323M2	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	06/07/2012
MW-338S	N1	Perchlorate	PCATE	SW6850	0.039	J	0.20	05/31/2012
MW-338S	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	05/31/2012
MW-344M2	N1	Perchlorate	PCATE	SW6850	1.1		0.20	06/06/2012
MW-344S	N1	Perchlorate	PCATE	SW6850	0.31		0.20	06/06/2012
MW-350M2	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	05/31/2012
MW-441M1	N1	Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	SW8330	0.58		0.20	11/08/2011
MW-441M1	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	11/08/2011
MW-441M1	N1	Perchlorate	PCATE	SW6850	0.054	J	0.20	05/31/2012
MW-441M1	N1	Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	SW8330	0.36		0.20	05/31/2012
MW-441M1	N1	ND for 18 Analytes	Explosives	SW8330	ND	U	ND	05/31/2012

Table 3-1
Northwest Corner Groundwater Monitoring Results
June 30, 2011 through June 30,2012

Well ID	Sample Type	Analyte	Parameter Label	Analytical Method	Results (ug/L)	Flag	Reporting Limit	Sampling Date
MW-441M2	N1	Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	SW8330	7.3		0.20	11/08/2011
MW-441M2	N1	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	SW8330	0.47		0.20	11/08/2011
MW-441M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	11/08/2011
MW-441M2	N1	Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	SW8330	11.0		0.20	05/31/2012
MW-441M2	N1	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	SW8330	0.87		0.20	05/31/2012
MW-441M2	N1	ND for 17 Analytes	Explosives	SW8330	ND	U	ND	05/31/2012
MW-441M2	FD1	Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	SW8330	10.9		0.20	05/31/2012
MW-441M2	FD1	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	SW8330	0.87		0.20	05/31/2012
RSNW01	N1	Perchlorate	PCATE	SW6850	0.60		0.20	05/21/2012
RSNW06	N1	Perchlorate	PCATE	SW6850	0.82		0.20	06/30/2011
RSNW06	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	06/30/2011
RSNW06	N1	Perchlorate	PCATE	SW6850	0.63		0.20	05/21/2012
RSNW06	N1	ND for 19 Analytes	Explosives	SW8330	ND	U	ND	05/21/2012

Table 5-1
Proposed Changes to
Groundwater Monitoring Well Network Sampling Frequency
Northwest Corner

					2011-2012		Proposed Frequency	
Well ID	Northing (UTM-m)	Easting (UTM-m)	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)	Sampling Frequency	Analysis	Sampling Frequency	Analysis
95-16	4622407.50	369652.50	4.3	-1.7	A	P	A	P
MW-270D	4623177.50	368703.03	-101.5	-106.5	A	P	A	E*,P
MW-270M1	4623177.00	368703.03	-43.5	-48.5	A	P	A	E*,P
MW-270S	4623177.50	368703.16	8.5	-1.5	A	P	A	P
MW-277M1	4623030.50	369437.16	-2.3	-12.3	S	P	S	P
MW-277S	4623030.50	369437.41	25.7	15.7	S	P	S	P
MW-278M1	4622755.50	369423.41	1.0	-9.0	A	P	A	P
MW-278M2	4622755.00	369423.41	17.0	12.0	A	P	A	P
MW-278S	4622755.00	369423.53	34.0	24.0	S	P	S	P
MW-279M1	4622651.50	369427.78	6.7	-3.3	A	P	A	P
MW-279M2	4622651.50	369427.78	19.7	14.7	A	P	A	P
MW-279S	4622651.50	369427.91	36.7	26.7	S	P	S	P
MW-283M1	4623204.50	368535.41	-24.4	-34.4	A	P	A	E*,P
MW-284M1	4623380.50	368799.16	-86.6	-96.6	A	E,P	A	E,P
MW-284M2	4623380.50	368799.13	-16.6	-26.6	A,S	E,P	A,S	E,P
MW-297M1	4623574.00	369028.25	-14.2	-24.2	A	P	A	P
MW-298S	4622331.61	369860.04	42.3	32.3	A	P	A	P
MW-309M1	4622968.17	368658.26	-18.9	-28.9	A	P	A	P
MW-309S	4622967.92	368658.25	14.1	4.1	A	P	A	P
MW-314S	4623743.05	369161.74	7.1	-2.9	A	P	A	P
MW-323M1	4622379.36	369378.03	-85.4	-95.4	A	E	A	E
MW-323M2	4622379.06	369378.33	-10.4	-20.4	A	E	A	E
MW-338S	4622313.74	369360.57	37.3	27.3	A	E,P	A	E,P
MW-344M2	4622925.24	370021.21	1.7	-8.3	A	P	A	P
MW-344S	4622925.54	370020.91	31.2	21.2	A	P	A	P
MW-350M2	4622217.89	369487.96	-3.0	-13.0	A	E	A	E
MW-441M1	4622180.35	369475.95	-88.4	-98.4	S,A	E,P	S,A	E,P
MW-441M2	4622180.40	369475.95	6.7	-3.3	S	E	S	E
RSNW01	4623486.00	369029.81	NA	NA	A	P	A	P
RSNW06	4623210.50	368903.38	NA	NA	A	E,P	A	E,P

Notes:

UTM-m - Universal Transverse Mercator meters

ft msl - feet above mean sea level

A - annual

S - semi-annual

P - perchlorate

E - Explosives

E* - Explosives analysis on a one time basis

N/A - not applicable

NA - not available

Denotes changes to sample frequency

Appendix A

Project Note – Changes to Northwest Corner Chemical Monitoring Network

PROJECT NOTE

Client, Project and Location:

Impact Area Groundwater Study Program
Northwest Corner Chemical Monitoring Network
Camp Edwards, MA

Subject: Changes to Northwest Corner Chemical Monitoring Well Network

Date: January 31, 2013



PURPOSE

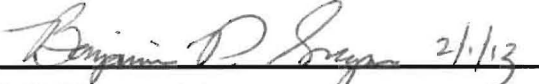
In September 2012, the Army National Guard's Impact Area Groundwater Study Program (IAGWSP) submitted the Draft Northwest Corner Environmental Monitoring Report, June 2011 through June 2011. Comments were received from the U.S. Environmental Protection Agency (USEPA) in a letter dated October 18, 2012 and from the Massachusetts Department of Environmental Protection in a letter dated October 15, 2012. A response to comment letter was written on November 9, 2012. EPA provided additional comments by e-mail on November 26, 2012. MassDEP provided additional comments during the common resolution meeting on December 13, 2012. A memorandum of resolution (MOR) for these comments was written on January 8, 2013. EPA and MassDEP approved the MOR in letters dated January 29, 2013, and January 16, 2013, respectively.

This Project Note (PN) documents agency concurrence with the changes to the chemical monitoring network as described in the draft report and based on agency comments. The attached table presents the approved chemical monitoring network.

CONCURRENCE

Concurrence with the agreements presented in this project note is represented by the signatures below:

 1/31/13	 1/31/2013
USEPA Representative	MassDEP Representative

 2/1/13

IAGWSP Representative

Table 1 Approved Changes to Groundwater Chemical Monitoring Well Network – Northwest Corner

Distribution: L. Jennings, B. Lim, D. Moyer (EPA); L. Pinaud and M. Panni (MassDEP); B. Gregson, D. Hill, and P. Richardson (IAGWSP); J. Ehret, G. Kaso, D. Brammer, M. Anderson, and M. Wojtas (USACE).

TABLE

Table 1
Approved Changes to
Groundwater Chemical Monitoring Well Network -
Northwest Corner

			2011-2012		Approved Sampling Program	
Well ID	Screen Top Elevation (msl ft)	Screen Bottom Elevation (msl ft)	Sampling Frequency	Analysis	Sampling Frequency	Analysis
95-16	4.3	-1.7	A	P	A	P
MW-270D	-101.5	-106.5	A	P	A	E*,P
MW-270M1	-43.5	-48.5	A	P	A	E*,P
MW-270S	8.5	-1.5	A	P	A	P
MW-277M1	-2.3	-12.3	S	P	S	P
MW-277S	25.7	15.7	S	P	S	P
MW-278M1	1.0	-9.0	A	P	A	P
MW-278M2	17.0	12.0	A	P	A	P
MW-278S	34.0	24.0	S	P	S	P
MW-279M1	6.7	-3.3	A	P	A	P
MW-279M2	19.7	14.7	A	P	A	P
MW-279S	36.7	26.7	S	P	S	P
MW-283M1	-24.4	-34.4	A	P	A	E*,P
MW-284M1	-86.6	-96.6	A	E,P	A	E,P
MW-284M2	-16.6	-26.6	A,S	E,P	A,S	E,P
MW-297M1	-14.2	-24.2	A	P	A	P
MW-298S	42.3	32.3	A	P	A	P
MW-309M1	-18.9	-28.9	A	P	A	P
MW-309S	14.1	4.1	A	P	A	P
MW-314S	7.1	-2.9	A	P	A	P
MW-323M1	-85.4	-95.4	A	E	A	E
MW-323M2	-10.4	-20.4	A	E	A	E
MW-338S	37.3	27.3	A	E,P	A	E,P
MW-344M2	1.7	-8.3	A	P	A	P
MW-344S	31.2	21.2	A	P	A	P
MW-350M2	-3.0	-13.0	A	E	A	E
MW-441M1	-88.4	-98.4	S,A	E,P	S,A	E,P
MW-441M2	6.7	-3.3	S	E	S	E
RSNW01	NA	NA	A	P	A	P
RSNW06	NA	NA	A	E,P	A	E,P

Notes:

UTM-m - Universal Transverse Mercator meters

ft msl - feet above mean sea level

A - annual

S - semi-annual

P - perchlorate

E - Explosives

E* - Explosives analysis on a one time basis

N/A - not applicable

NA - not available

Denotes changes to sampling program

Appendix B
Memorandum of Resolution for the Draft Northwest Corner Environmental
Monitoring Report, June 2011 through June 2012



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
BOSTON, MA 02114-2023

January 29, 2013

MAJ Shawn Cody
Impact Area Groundwater Study Program Office
PB 0516 West Outer Road
Camp Edwards, MA 02542

Re: Memorandum of Resolution on *Draft Northwest Corner Environmental Monitoring Report, June 2011 through 2012*

Dear MAJ Cody:

EPA has completed its review of the Memorandum of Resolution letter on the *Draft Northwest Corner Environmental Monitoring Report, June 2011 through 2012* dated January 8, 2013. The investigation and cleanup at Northwest Corner has been conducted pursuant to United States Environmental Protection Agency (EPA) Administrative Order SDWA 1-2000-0014 (AO3) and in consideration of the substantive cleanup standards of the Massachusetts Contingency Plan. EPA accepts the resolutions in the letter and recommends finalization of the document. If you have any questions, please do not hesitate to call Robert Lim at (617) 918-1392 or me at (617) 918-1210.

Sincerely,

A handwritten signature in black ink that reads "Robert Lim for". The signature is written in a cursive, flowing style.

Lynne A. Jennings
MMR Team Leader

cc: Robert Lim/EPA
Benjamin Gregson/IAGWSP
Dave Hill/IAGWSP
Gina Kaso/ACOE
Len Pinaud/MassDEP



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

January 16, 2013

MAJ Shawn Cody
Impact Area Groundwater Study Program
PB 0516 West Outer Road
Camp Edwards, MA 02542

RE: **BOURNE**
Release Tracking Number: 4-0015031
Massachusetts Military Reservation (MMR)
**Draft Northwest Corner Environmental
Monitoring Report June 2011 through
June 2012 - MOR, Concurrence**

Dear MAJ Cody:

The Massachusetts Department of Environmental Protection ("MassDEP") reviewed the Memorandum of Resolution (the "MOR") dated January 8, 2013 issued for the document entitled "**Draft Northwest Corner Environmental Monitoring Report June 2011 through June 2012**" dated September, 2012. The MOR was prepared by the U.S. Army Corps of Engineers (USACE) on behalf of the US Army National Guard Impact Area Groundwater Study Program (IAGWSP) at the Massachusetts Military Reservation (MMR).

MassDEP concurs with the MOR.

Please incorporate this letter into the Administrative Record for the Northwest Corner Study Area. If you have any questions regarding this matter, please contact me at (508) 946-2871 or Elliott Jacobs at (508) 946-2786.

Sincerely,

*This final document copy is being provided to you electronically by the
Department of Environmental Protection. A signed copy of this document
is on file at the DEP office listed on the letterhead.*

Leonard J. Pinaud, Chief
State & Federal Site Management Section
Bureau of Waste Site Cleanup

P/EJ/lm

4-0015031.NWC MON COM MOR.01-15-2013.docx

This information is available in alternate format. Call Michelle Waters-Ekanem, Diversity Director, at 617-292-5751. TDD# 1-866-539-7622 or 1-617-574-6868
MassDEP Website: www.mass.gov/dep

Printed on Recycled Paper

ecc: Philip Weinberg, Regional Director
Millie Garcia-Serrano, Deputy Regional Director
MassDEP Boston
MassDEP Southeast Regional Office
MMR Senior Management Board
MMR Cleanup Team
Upper Cape Boards of Selectmen
Upper Cape Boards of Health



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

January 8, 2013

Engineering/Planning Division
Geo-Environmental Engineering Branch

Ms. Lynne Jennings
EPA – New England, Region 1
5 Post Office Square – Suite 100
Mail Code OSRR7-3
Boston, Massachusetts 02109-3912

Mr. Len Pinaud
Massachusetts Department of Environmental Protection
20 Riverside Drive
Lakeville, Massachusetts 02347

Re: Impact Area Groundwater Study Program
USEPA Region I Administrative Orders SDWA 1-97-1019 and 1-2000-0014
Memorandum of Resolution for the Draft Northwest Corner Environmental Monitoring
Report, June 2011 through June 2012

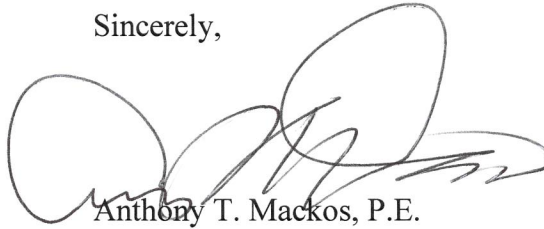
Dear Ms. Jennings and Mr. Pinaud:

On behalf of the National Guard's Impact Area Groundwater Study Program (IAGWSP), the U.S. Army Corps of Engineers (USACE) is pleased to provide the enclosed Memorandum of Resolution (MOR). This MOR is for U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (MassDEP) comments on the Responses to Comments Letter (RCL), dated November 9, 2012, for the Draft Northwest Corner Environmental Monitoring Report, June 2011 through June 2012, dated September 2012. Comments were received on the Draft report from EPA in a letter dated October 18, 2012, and from the MassDEP in a letter dated October 15, 2012. EPA provided additional comments by e-mail on November 26, 2012. MassDEP provided subsequent comments during the comment resolution meeting (CRM) on December 13, 2012.

Your approval of the enclosed MOR is requested by January 22, 2013.

Please contact Dave Hill of the IAGWSP or Mark Anderson of USACE if there are any questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Anthony T. Mackos', is written over the printed name.

Anthony T. Mackos, P.E.
Chief, Engineering/Planning Division

Enclosure

Copy Furnished:

Hard Copy:

EPA: Bob Lim

Electronic:

IAGWSP: Ben Gregson, Dave Hill, Marcia Goulet

EPA: Erin Sanborn

USACE: Gina Kaso, Jay Ehret, Mark Anderson, Mike Kulbersh, Mark Koenig, Marie Wojtas

Impact Area Groundwater Study Program
Memorandum of Resolution to US Environmental Protection Agency and
Massachusetts Department of Environmental Protection Comments on the
Draft Northwest Corner Environmental Monitoring Report
June 2011 through June 2012, Dated September 2012

Subsequent Comments from US Environmental Protection Agency via E-Mail of 26 November 2012

GENERAL COMMENT

- 1. Comment:** Section 4.0 Monitoring Trends-EPA requests that this section be rewritten to incorporate predictions from the decision document and an evaluation for the results against these predictions. The decision document outlined that contamination within the broad perchlorate plume is expected to drop below the 2 µg/L MMCL by 2012 and the 0.35 µg/L background level by 2019. Contamination within the narrow RDX plume is expected to drop below the 2 µg/L health advisory by 2012, the 0.6 µg/L 10⁻⁶ risk-based concentration by 2022, and the 0.25 µg/L background level by 2044. This monitoring report presents RDX detections ranging from 0.34 µg/L to 11 µg/L and Perchlorate detections ranging from 0.0391 µg/L to 3.39 µg/L. The most recent maximums are Perchlorate at 2.6 µg/L at MW-284M2 (6/5/12), and RDX at 10.9 µg/L at MW-441M2 (5/31/12).

EPA reiterates that the goals in the DD are critical and if we are not achieving them, we need to understand why we are not achieving them; decide if we need to do something further; and decide if we need to amend the DD. This report and long-term monitoring reports for other plumes need to address this issue.

At a minimum, the report should provide a revised assessment as to when cleanup goals as stated in the DD will be achieved. The report should also provide explanation as to what may be causing the deviation from the original modeled predictions. With this information in hand, a decision on additional actions, if needed, can be taken.

Provide draft text in the response to this comment.

Response: With respect to addressing whether Decision Document criteria are being achieved, this issue is more appropriately addressed in the Five Year Review (FYR) than in individual annual reports. However, for information purposes, the RI/FS plume shells were constructed based on data through November 2006. Presently, the numerical fate and transport model depicts that the perchlorate plume is located approximately 400 feet upgradient of the canal 5.5 years after development of the plume shell. However, based on recent measurements the perchlorate plume has been drawn to be approximately 3600 feet upgradient of the canal. Currently, two wells (MW-279M2 & MW-284M2) have concentrations exceeding 2 µg/L. The lingering of the plume can likely be attributed to perchlorate mass in the unsaturated zone along Canal View Road leaching longer than expected. Wells MW-298S and 95-16 are located upgradient and east of MW-279M2 and are currently below 0.35 µg/L. Thus, as clearly visible from the hydrograph depicted on Figure 4-3, MW-279M2/S continues to display a diminishing trailing edge of the perchlorate plume. When perchlorate drops below 2 µg/L in MW-279M2, it will then take approximately 5-6 years to traverse the site based on advective flow (unattenuated) and discharge to the canal. As such, the most upgradient portion of the plume would reach the canal by 2019-2020 and background concentrations (0.35 µg/L) should occur shortly thereafter. This information will be included in the revised FYR.

With respect to RDX, at the time the plume shell was developed (November 2006), RDX was non-detect in MW-441M2, the furthest upgradient well in the NWC operable unit. As depicted in Figure 4-1, concentrations increased from ND (< 0.25 µg/L) in May 2008 to 9.4

**Impact Area Groundwater Study Program
Memorandum of Resolution to US Environmental Protection Agency and
Massachusetts Department of Environmental Protection Comments on the
Draft Northwest Corner Environmental Monitoring Report
June 2011 through June 2012, Dated September 2012**

µg/L in April 2009 and has been above 2 µg/L since. Unfortunately, the next closest upgradient well is over 3000 feet away and the terrain in between is quite rugged. A series of profile samples located approximately 1650 feet upgradient of MW-441 were collected from borings DP-373 through DP-376 and DP-394 beginning in May 2005. RDX results in these samples did not exceed 2 µg/L. Since no wells were installed at these locations determination of a cleanup time frame with any certainty is not currently possible, as the RDX plume is not well defined in the area immediately upgradient of MW-441M2.

Additional Comment: I can't approve the RCL as is and am requesting a comment resolution meeting at the next tech update meeting date. We need to create a resolution for general comment #1 and specific comment #1 [assumed to be specific comment #2].

Resolution: A new estimate of plume cleanup times will be provided in the final annual report. In the case of perchlorate, based on advective flow and assuming no additional source contribution, perchlorate would be below 2 µg/L by 2019-2020 and to background shortly thereafter. In the case of RDX, the most upgradient well in the NWC network, MW-441M2 measured 11 µg/L during the current reporting period. Until concentrations of RDX fall below 2 µg/L a reliable estimate of time to cleanup cannot be established. However, once concentrations are below 2 µg/L, the advective time of travel to the canal is approximately 8 years. So, at a minimum, concentrations of 2 µg/L throughout the plume would not be achieved until 2020.

The following text will be added to the newly established Section 4.3:

4.3 Comparison to Decision Document Criteria

“The Decision Document outlined that contamination within the broad perchlorate plume is expected to drop below the 2 µg/L MMCL by 2012 and the 0.35 µg/L background level by 2019. Contamination within the narrow RDX plume is expected to drop below the 2 µg/L health advisory by 2012, the 0.6 µg/L 10-6 risk-based concentration by 2022, and the 0.25 µg/L background level by 2044. The numerical fate and transport model depicts that the perchlorate plume is located approximately 400 feet upgradient of the canal as of 2012.5 (5.5 years after plume shell development November 2006). However, based on recent measurements the perchlorate plume has been drawn to be approximately 3600 feet upgradient of the canal. Currently, two wells (MW-279M2 & MW-284M2) have concentrations exceeding 2 µg/L. The lingering of the plume can likely be attributed to residual leaching of perchlorate mass in the unsaturated zone along Canal View Road. Wells MW-298S and 95-16 are located upgradient and east of MW-279M2 and are currently below 0.35 µg/L. Thus, as clearly visible from the hydrograph depicted on Figure 4-3, MW-279M2/S continues to display a diminishing trailing edge of the perchlorate plume. When perchlorate drops below 2 µg/L in MW-279M2, it will then take approximately 5-6 years, based on advective flow (unattenuated), to fully discharge to the canal. As such, the most upgradient portion of the plume would reach the canal by 2019-2020 and background concentrations (0.35 µg/L) should occur shortly thereafter.

**Impact Area Groundwater Study Program
Memorandum of Resolution to US Environmental Protection Agency and
Massachusetts Department of Environmental Protection Comments on the
Draft Northwest Corner Environmental Monitoring Report
June 2011 through June 2012, Dated September 2012**

With respect to RDX, at the time the plume shell was developed (November 2006), RDX was non-detect in MW-441M2, the furthest upgradient well in the NWC operable unit. As depicted in Figure 4-1, concentrations increased from ND ($< 0.25 \mu\text{g/L}$) in May 2008 to $9.4 \mu\text{g/L}$ in April 2009 and have been above $2 \mu\text{g/L}$ since. Unfortunately, the next closest upgradient well is over 3000 feet away and the terrain in between is quite rugged. A series of profile samples located approximately 1650 feet upgradient of MW-441 were collected from borings DP-373 through DP-376 and DP-394 beginning in May 2005. RDX results in these samples did not exceed $2 \mu\text{g/L}$. Therefore, until concentrations of RDX fall below $2 \mu\text{g/L}$ a reliable estimate of time to cleanup cannot be established. However, once concentrations are below $2 \mu\text{g/L}$ at MW-441M2, the advective time of travel to the canal is approximately 8 years. So at a minimum, concentrations of $2 \mu\text{g/L}$ throughout the RDX plume would not be achieved until 2020.”

Also, the following Recommendation will be added to the report:

“Annually evaluate the model predicted plume contours to measured values and determine whether significant variances are likely within cleanup time frames published in the Decision Document. If so, the groundwater flow model will be used to estimate revised times of cleanup, if feasible. “

SPECIFIC COMMENTS

2. Page 9, Section 5.0-Include recommendation(s) to address the above General Comment# 1.

Response: As indicated in the response to General Comment 1, the NWC Annual Report is intended primarily to present monitoring data and identify trends. It is recommended that the requested information and comparative analysis be incorporated into the revised FYR

Additional Comment: I can't approve the RCL as is and am requesting a comment resolution meeting at the next tech update meeting date. We need to create a resolution for general comment #1 and specific comment #1 [assumed to be specific comment #2].

Resolution: Based on the response to General Comment 1 the following recommendation will be added to the Annual Report:

“Annually evaluate the model predicted plume contours to measured values and determine whether significant variances are likely within cleanup time frames published in the Decision Document. If so, the groundwater flow model will be used to estimate revised times of cleanup, if feasible. “

**Impact Area Groundwater Study Program
Memorandum of Resolution to US Environmental Protection Agency and
Massachusetts Department of Environmental Protection Comments on the
Draft Northwest Corner Environmental Monitoring Report
June 2011 through June 2012, Dated September 2012**

Subsequent Comments from Massachusetts Department of Environmental Protection at Comment Resolution Meeting of 13 December 2012

Page-specific Comment:

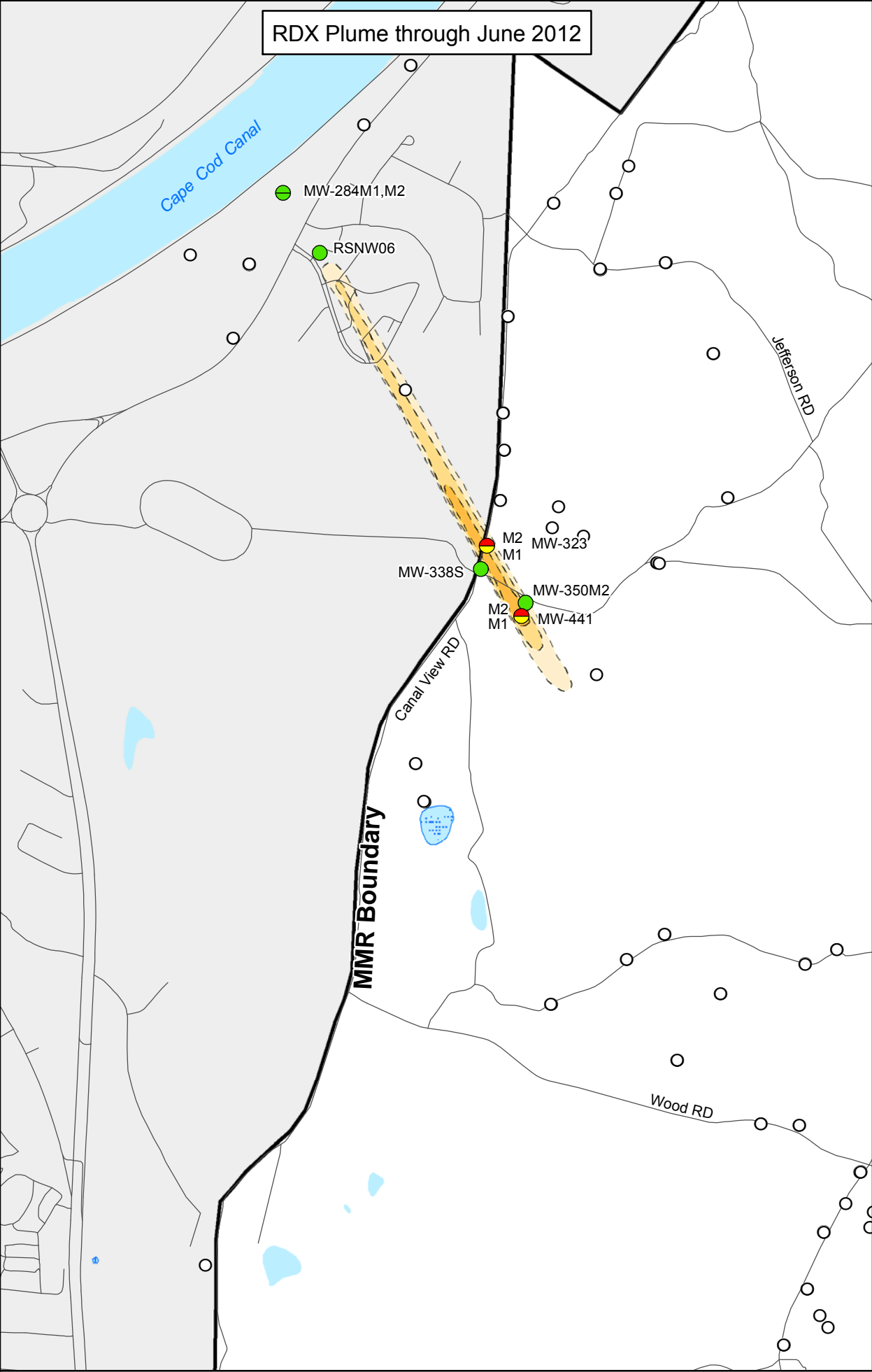
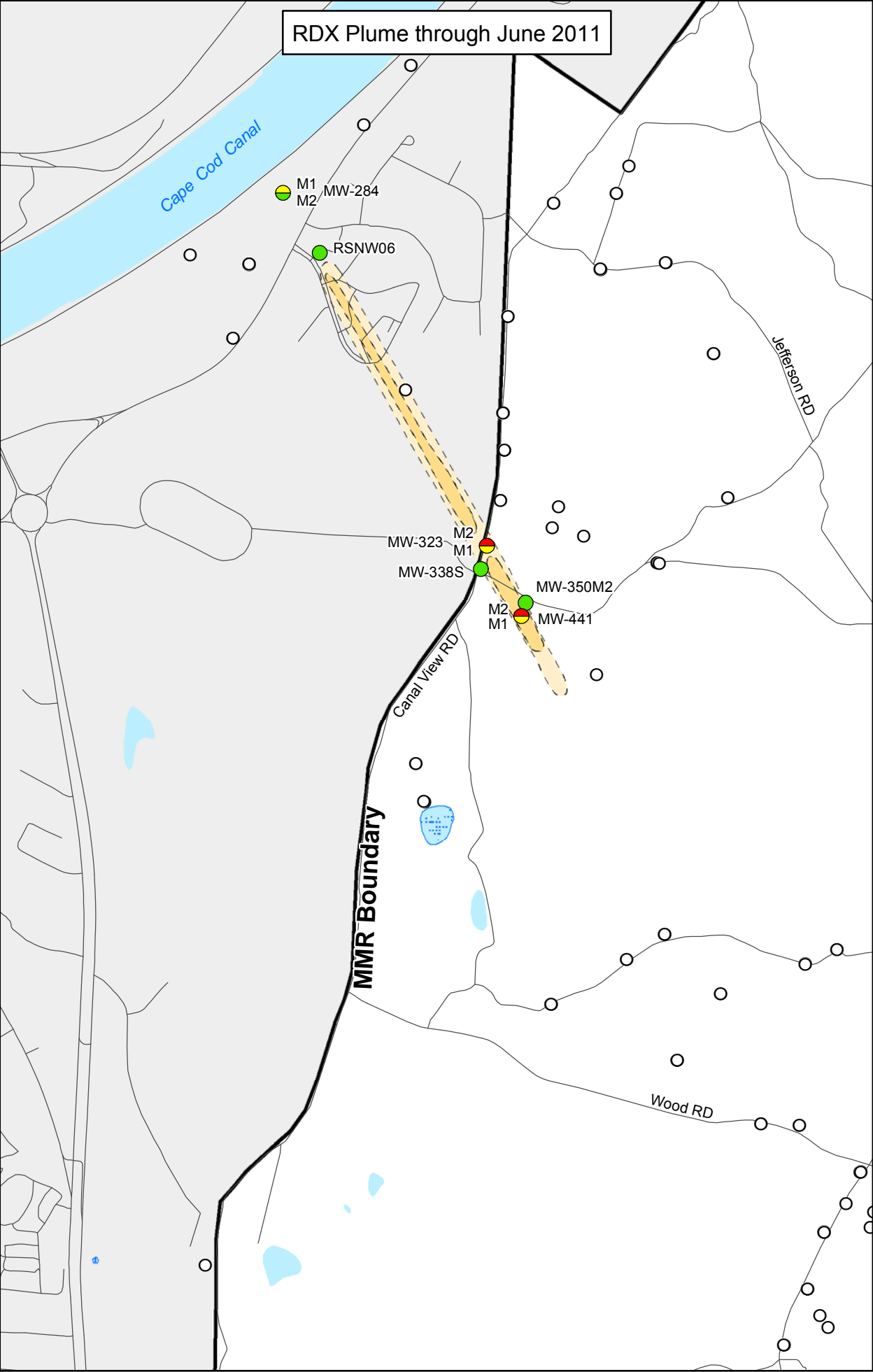
Page 6, Section 4.1 EXPLOSIVES:


The text states, “**A comparison between the RDX plume contoured with data through June 2011 and through June 2012 is presented in Figure 4-2.**” MassDEP notes that the headings for the 2011 and 2012 RDX plume depictions in Figure 4-2 appear to be switched (i.e. 2011 heading on 2012 RDX distribution and vice versa). Also, the RDX shading on the illustration of the RDX plume through June 2012 in Figure 4-2 should be revised in the vicinity of MW-441M2 to reflect the RDX concentration of 11 µg/L that was detected in this well in May 2012.

Response: Figure 4-2 is not labeled incorrectly. The left pane is the RDX depiction through June 2011 and the right pane is the RDX plume depicted through June 2012. Furthermore, in the right pane well MW-441M2 is depicted in the RDX contour from 6 to 20 µg/L, and respects the 11 µg/L RDX concentration detected in May 2012.

Additional Comment: Further clarification of the figure is requested.

Resolution: Based on groundwater flow direction coupled with RDX contaminant trends depicted in Figure 4-1, it is believed that the plume width as depicted in Figure 4-2 does not hold true to the non-detect concentrations measured in wells MW-338S and MW-350M2. The RDX plume was redrawn, see attached, so that the 0.6 µg/L and internal contours adhere to these non-detects.



**Impact Area
Groundwater Study Program**

LEGEND

Monitoring Wells

- Well Not Included in RDX Monitoring Plan
- No Detection
- Detection at or below 0.6 g/L
- Detection above 0.6 g/L
- Indicates different detections in different well screens

RDX in Groundwater
(Contours Dashed Where Inferred)

- 0.6 to 2 g/L
- 2 to 6 g/L
- 6 to 20 g/L

▬ MMR Boundary

▬ Impact Area Boundary

Note: Contour lines dashed where inferred.

LOCATION MAP


NOTES & SOURCES


Basemap data from US Geological Survey 7 1/2 minute Topographic Maps. Source: MassGIS

TITLE

Northwest Corner
Environmental Monitoring Program
RDX Plumes
June 2011 and June 2012

0 1,250
Feet





US Army Corps
of Engineers
New England District

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M:\MMR\2012\NWC\AnnRpt\MXD\Fig4-2_010213Rev1.mxd
January 3, 2013 DWN: MTW REV: PDM CHKD: MRK

FIGURE
4-2